FORESIGHT LAND USE FUTURES PROJECT

FINDINGS FROM THE RURAL ECONOMY AND LAND USE (RELU) PROJECTS CONTRIBUTING TO THE LAND USE FUTURES PROJECT

Dr Alan Woods – Consultant Land Use Policy Analyst

CONTENTS

30 July 2009

EXECUTIVE SUMMARY

This paper presents some early findings from Relu projects that contribute to current discussions within the Foresight Land Use Project.

Findings on governance and scale issues include:

1. Better communication and engagement are needed at all levels, between all interested parties.
2. A more equitable relationship among stakeholders is needed, based on shared knowledge.
3. Mapping stakeholder interests and influences helps understand motivations and behaviours.
4. It is critical to engage land managers in decisions about delivering ecosystem services.
5. Dialogue at the outset over research design and development will build shared understanding.
6. Those involved in decisions need to recognise the validity of different types of knowledge.
7. Achieving a 'joined-up', integrated, multipurpose approach to land management based on an ecosystems approach will require diverse barriers (listed in the paper) to be overcome.
8. Governance frameworks focused on decisions made by individual farmers sit uneasily with this objective. Several projects point to the need to work with communities rather than individuals.
9. Making explicit the potential conflicts and synergies between ecosystem services is critical.
10. Schemes to encourage sustainable practices across farms can be 'undone' by individuals.
11. Group agreements could be used to deliver coordinated action across several farms.
12. Local adaptation and innovation are needed in policy implementation, not 'blueprint' solutions.
13. Collaboration between players at national level will not necessarily be replicated at local levels.
14. Bureaucracy in working across institutional boundaries can discourage people.
15. Two-way, top-down and bottom-up communication is needed within national organisations.
16. National institutions should seek out local initiatives that may need support.
17. Local authorities could play a stronger role in spatial planning for land management.

Findings on the motivations of land managers include:

18. The diversity of land managers and the heterogeneity of their motivations mean that varied and sometimes unexpected responses to policy interventions should be expected.
19. This unpredictability poses a challenge for policy-makers, but also presents opportunities.
20. Farmers' motivations are not discrete or necessarily stable. They are complex and shift according to social and political influences.
21. Farmers wrestle with internal conflicts: typically they want to be 'farmers', but they are aware of, and would prefer to avoid, the environmental risks associated with intensive farming.
22. A 'making do' mindset among some farmers reflects a lack of motivation to innovate, scepticism about being constantly pressured into 'new practices', and a concern that innovation can increase risk.
23. Access to farm-level analytical and advisory support is critical in sustaining behavioural change.
24. A voluntary approach is the preferred means to encourage collaboration.
25. Voluntary groups could be used to tackle environmental challenges where scale and connectivity in the landscape are important.
26. Community-based approaches contrast with the individualistic approach to farming and rural development traditionally fostered by farming policy.

Findings on tackling land use challenges at source include:

27. Clarity is needed about whether problems relate to the source, pathway, or receptor.
28. Action at source, while necessary, may not be sufficient.
29. Working with natural processes need not exclude engineering solutions.
30. Working with all interested parties to encourage community understanding and ownership of problems can lead to valuable voluntary initiatives to effect change.
31. Work to tackle water discoloration caused by eroded peat suggests that, without new incentives, reducing sheep numbers and increasing burning would exacerbate the problem.
32. Decision tools can play a valuable role in helping land managers to understand and minimise transfers of pathogenic micro-organisms from livestock manure into rivers.
33. Modelling results suggest that policy interventions at one level can minimise the need to develop compensatory interventions at different levels.

1. INTRODUCTION

1.1 This paper presents some early findings from Relu projects that contribute to current discussions within the Foresight Land Use Futures Project. These findings touch specifically on issues of scale, land manager motivations, and the benefits of tackling challenges at source. The paper builds on a draft which was circulated to all the projects featured in the earlier Relu report *Securing Integrated Land Management*. These projects are listed in the Annex. I am very grateful for the valuable responses received, but take full responsibility for synthesising them.

2. LAND USE GOVERNANCE

2.1 The Foresight Project is exploring how governance arrangements for land use might be improved to deliver long-term inter-generational sustainability. Interest lies in who makes decisions about land use and management, who influences them or has an opportunity to do so, how decisions are made, and at what scale they are made (e.g. farm, catchment, landscape, local authority, region or nation). Evidence is sought on decisions currently taken at inappropriate scales and which might have a disproportionate impact on land use outcomes; on alternative approaches; and on barriers to the re-shaping of governance frameworks.

Who to involve

2.2 Relu researchers have underlined the importance of each of the components of land use governance. They recognise that the players are diverse: land managers, scientists, government departments, public agencies, local authorities, voluntary organisations, and so on. They particularly stress the need to engage land managers in decisions because of their critical role in delivering public objectives on private land. Plans created by external stakeholders will fail unless they involve those who will be expected to deliver them. This is a particular challenge in developing management plans at the landscape scale.

2.3 Several Relu projects emphasise the value of mapping stakeholder interests and influences, especially those linked to specific ecosystem services. Land use patterns reflect dominant influences and entitlements, usually associated with land ownership and occupation. Non-marketed, public-good benefits are less well served by property rights, unless policy measures such as regulations or economic incentives are applied. The **Floodplains** and **Biodiverse Farming Projects** have developed a system for mapping stakeholder interests to help understand the motivations and behaviour of external stakeholders alongside those of land managers; and the scope to promote cooperation and resolve conflicts.

How to make decisions

2.4 The projects stress the need for better communication and engagement at all levels between all interested parties. The **Deer Project** suggests that there is confusion about public objectives and that participatory approaches can foster better communication and negotiation at local levels. It used a Participatory Geographical Information System to model deer populations at the landscape scale, integrate stakeholder knowledge with scientific research to develop shared understanding, and create a framework for adding new knowledge and for evaluating the impact of changes in land use policy and the climate.

2.5 Relu projects also make the point that those involved in decisions need to recognise the validity of different types of knowledge, including local knowledge, professional expertise and the results of scientific analysis. The **Floodplains Project** suggests that different perspectives and approaches can be creatively combined to establish a bigger picture (e.g. cost-benefit techniques and deliberative methods; or qualitative and quantitative analysis). The **Deer Project** found that land managers' knowledge improved their scientific model of deer range use. Dialogue at the outset over the design and development of research, not

just at the end over the results, helps to build shared understanding. It also helps with the critical need to promote a more equitable relationship among stakeholders, based on shared knowledge.

Issues related to scale

2.6 Issues of scale cannot be separated clearly from discussions about who should be involved in land use decisions and how. In practice, any decision is made within a governance framework operating at several scales and involving diverse players, each with access to different sets of information. A decision to enter a field into an English agri-environment scheme may be taken by a farmer (farm scale) but the framework for that decision will have been influenced by the Common Agricultural Policy (EU scale); implementing regulations (national scale); guidelines from Natural England on what management options to make available where (England or regional scale); and by inputs, through consultation, from stakeholder groups and the public. The farmer may make the decision and sign the agreement; but the option to make that decision, and much of its content, will have been determined at quite different spatial scales.

2.7 A governance framework focused on decisions made by individual farmers owes a great deal to the existing framework of private property rights. It sits uneasily with an approach that seeks to deliver the full range of ecosystem services from the land. This is because no one scale is appropriate for planning and securing the delivery of all services. For example: marsh fritillary butterflies require sensitive management of vegetation at a field scale; food production is managed at a farm scale; golden eagles require a mix of habitats at a landscape scale; water quality is best considered at a catchment scale; a regional scale is appropriate in considering how to improve the resilience of major habitats to climate change; and strategies for protecting carbon sinks may best be developed at a national scale.

Different models for governance

2.8 These scale challenges immediately raise ‘how’ questions. Relu projects again emphasise the need for dialogue and collaboration. They suggest that governance frameworks should be flexible, to enable different patterns of leadership, decision-making authority and supporting roles to emerge at different scales for different problems.

2.9 The **Floodplains Project** uses the case of lowland floodplains to explore how land and water resources can be managed to deliver a range of different ecosystem services, including food production, biodiversity and flood risk management. The **Project** suggests that identifying, understanding and making explicit the potential conflicts and synergies between these ecosystem services, and how these might vary under different management regimes, is critical. This understanding will enable relevant stakeholders to work at joining up fragmented and even conflicting policy regimes. However, taking a more rounded, holistic, view of land will require a substantial shift in embedded sectoral approaches.

2.10 The **Catchment Management Project** is studying international examples of collaborative approaches to protecting water quality. It emphasises the need for local adaptation and innovation in policy implementation rather than ‘blueprint’ solutions. It suggests that governance processes are most effective when local interests are engaged from the outset in framing the problem and defining the available options. This helps to build shared understanding of problems, opportunities and constraints and to foster partnership working. Monitoring and reporting outcomes helps sustain commitment. Accountability could be strengthened if local authorities played a stronger role in spatial planning for land management and in targeting measures, but this raises questions about their capacity.

2.11 The **Floodplains Project** points to some of the barriers to the adoption and implementation of a 'joined-up', integrated, multipurpose approach to land management, based on an ecosystems approach. These barriers include:

- Established property and entitlement regimes and legal frameworks. These serve dominant interests that focus on particular functions and outputs to the exclusion of others.
- Market failure associated with inadequate recognition of non-marketed services, with implications for current and future public welfare.
- Conflicting interests (and inertia) among different stakeholders, as well as hidden and underexploited synergies over different spatial and temporal scales.
- Challenges associated with metrics and valuation, especially for non-marketed services.
- Fragmentation of policies and funding, which tends to promote conflict and limit synergy; this often reflects silo-based administrative and policy domains.
- The loss of capabilities in managing diversity. New technologies mainly promote dominant interests and functional specialisation.
- Lack of capabilities and experience in integrated and multifunctional approaches, and of supporting science and technology.
- Reduced social capacity for collective and collaborative action, unless it is driven by immediate threats or contentious issues.

Lessons for national agencies

2.12 Several projects provide insights into the role of national agencies and how they work with people on the ground to deliver policies that have been devised at a national level. The **Deer Project** suggests that a lack of national policy coordination between laws and institutions frustrates local action to manage wild deer herds. It also cannot be assumed that national collaboration between government agencies, voluntary bodies and land manager representatives will be replicated locally. Lack of local communication, understanding or respect may be significant barriers. The **Project** stresses the need for two-way communication from the national level to local staff, to help them to engage more effectively with local stakeholders, and from inclusive local groupings up to the national level to ensure that local issues and ideas feed into national-level policies and plans.

2.13 The **Community Catchment Management Project** indicates that working across institutional boundaries is difficult, especially if it is not an established practice for institutions and communities. Bureaucracy can make people feel that the effort of co-operating is not worthwhile. Sometimes the red tape may reflect a concern on the institution's part not to lose control. But perhaps some degree of control must be lost, and new responsibilities must be allowed to emerge, if local communities are to become more active in managing their local environment. The **Project** also suggests that institutions such as the Environment Agency, Natural England and the Regional Development Agencies should seek out local initiatives, which may need support, and should identify and promote precedents for others to adopt.

Securing landscape-scale action

2.14 Securing desired outcomes across several farms presents particular challenges because current policy mechanisms focus on agreements with individual farmers, reflecting the established legal framework of private property rights and responsibilities. The **Community Catchment Management Project** points out that while farmers do know how to collaborate, they are incentivised as individuals rather than as a community. This can produce unexpected effects. Schemes designed to encourage sustainable practices across many farms in a catchment have been undone to some extent by the actions of individual farmers who have used the payments to fund new and unsustainable lines of production.2.15 Do new mechanisms need to be found to plan and secure coordinated action across several farms, and to deliver this action through group agreements? Few schemes reward farmers for viewing land management issues as a group, developing a consensus, and delivering collaborative action, on their own initiative or through peer pressure. The **Community**

Catchment Management Project suggests that there are opportunities to learn from precedents. These include existing group agreements (e.g. for the management of common land grazing), and evidence of historical neighbourhood cooperation. This shows that even the most individualistic of farmers will work together at specific times.

Further projects considering spatial issues

2.16 The **Organic Project** focuses on the spatial pattern of adoption of organic farming and its benefits. It seeks to understand what causes organic farms to be arranged in clusters at local, regional and national scales, rather than to be spread more evenly throughout the landscape. The Project is also investigating whether there is any greater benefit to biodiversity if the farms are clustered, or if individual organic fields are widely scattered. These findings will also help to inform the debate about the extent to which incentives and support should be directed at land managers as individuals, or as clusters or groups.

2.17 The **Energy Crops Project** examines the impacts of large-scale planting of energy crops at a regional scale to achieve targets set at national level. One problem is that data on impacts tend to be collected and experienced at field scale. The impacts depend among other factors on the size and distribution of the power plants supplied by the crops, which can require either local or regional supplies of biomass fuel. The Project brings all the different scales together to determine the sustainability implications of different planting scenarios.

2.18 The **Water Framework Directive Project** considers all types of farming and derives a land use model which embraces all of the major drivers of activities. These include markets (fluctuations in prices and costs); policy (both explicit agricultural Directives and those which indirectly affect land use, such as the Water Framework Directive); and the environment (both cross-sectional variation between different areas of land and time-series fluctuation due to environmental change).

3. THE MOTIVATIONS OF LAND MANAGERS

3.1 The Foresight Project has commissioned reviews of the role of land managers, and is drawing on case studies of the role of partnerships and community involvement in delivering desired outcomes. It is particularly interested in understanding how the delivery of these outcomes is affected by land managers' motivations. The heterogeneity of these motivations means that we may expect varied and sometimes unexpected responses to policy interventions. While this unpredictability poses a challenge for policy-makers, it also provides opportunities to develop new and more effective options for policy design. The Relu programme is contributing a range of insights from its work with land managers.

The nature of motivations

3.2 It is well-known that land managers are a diverse group. They include agri-businesses, family farms, businesses focused on niche markets, contractors, lifestyle entrants, foresters, equine enterprises, voluntary bodies, water companies, and, not least, the State. The fourth-generation family farm producing basic commodities is not typical. This heterogeneity is reflected in the diverse motivations of land managers. These are determined by a wide range of social, cultural, attitudinal and structural factors.

3.3 The **Community Catchment Management Project** has found that farmers' motivations are not discrete or necessarily stable. They are complex and relational (i.e. they shift according to social and political influences) and must be viewed as social, not just individual, phenomena. The **Project** has noted that a 'making do' mindset among farmers in the catchment reflects a lack of motivation to innovate and scepticism about being constantly pressured into new practices that do not seem to make things any better. They also fear that innovation can increase risks to farming businesses which already experience volatile returns from year to year.

Managing conflicting objectives and policy signals

3.4 The **Floodplains Project**, which focuses on changes in land use within drained catchments reports that farmers wrestle with internal conflicts. They want to be farmers as the term is traditionally understood. But they are also aware of, and would prefer to avoid, the environmental risks associated with the intensive farming which has been encouraged by policy or which is necessary to ensure the viability of their businesses. The Project has also found some confusion among farmers, given the varying policy signals, about whether maximising output or relying on environmental payments is the best strategy for guaranteeing their livelihoods in future. This suggests a need for policy-makers to set clear strategic goals.

Delivering behavioural change

3.5 The **Catchment Management Project** stresses the importance of sustained and long-term approaches to environmental problems. It is deriving lessons from international experience about how education, advice, incentives and regulation can best be structured and delivered to achieve behavioural change, mutually beneficial outcomes and multiple objectives. The **Project** has highlighted the importance of farm-level analytical and advisory support from trusted local advisors. It suggests that sustained behavioural changes and land management benefits are unlikely to be delivered through frequently-changing incentive schemes delivered by consultants from elsewhere, and employed on low-cost, short-term contracts. The **Project** suggests that analytical and advisory services could be sourced through local authorities, working with local partner agencies, water companies, consultants, local universities and voluntary bodies.

Encouraging collaboration

3.6 The **Deer Project** has investigated decision-making among land managers and studied how decisions would change under scenarios where collaboration took place or incentives were available. The **Project** recommends a collaborative approach to realising public and private objectives for hill land. It needs to be flexible to adapt to change, and should involve land managers, as well as local people and public bodies, in developing strategies and plans. This approach will be important in resolving conflicts between traditional ecosystem services (e.g. hunting, farming and biodiversity) and for considering how to optimise potential synergies and trade-offs with new demands (e.g. to sequester carbon). The **Project** suggests that a voluntary approach tailored to local circumstances at specific sites, perhaps supported by financial incentives in some areas, is the best way to encourage further collaboration in deer management.

3.7 The **Catchment Management Project** reports on the formation of irrigation groups by farmers in East Anglia to negotiate and promote the sharing of water resources under drought conditions. The groups have developed their own rules of engagement and self-police voluntary agreements for water use by members. The **Project** suggests that such groups could be used to tackle other environmental challenges where scale and connectivity in the landscape are important. They could also be targeted by policy action. The Environment Agency uses the Anglian groups to focus dialogue about managing irrigation water. This community-based approach contrasts with the individualistic approach to farming

and rural development traditionally fostered by farming policy.

Further projects considering motivational issues

3.8 The **Hill Farming Project** examines how farmers respond to policy changes and how their actions affect biodiversity. The **Project** has constructed a series of models for representative farm types in the Peak District, and used them to simulate how profit-maximising farmers would respond to changes such as decoupling of subsidies from production, the reform of agri-environment policy, and the loss of the Single Farm Payment. The predicted outcomes relate both to farm incomes and to changes in land management. These land management changes have then been related to impacts on biodiversity, using a statistical model which captures the complex relationships between land use (e.g. stocking rates) and a variety of biodiversity indicators centred on farmland birds. The **Project** has also quantified the trade-offs between farm incomes and biodiversity conservation, and the incentives needed to ensure spatial coordination between farmers at the landscape scale.

3.9 The **Energy Crops Project** has surveyed growers to understand why they grow biomass crops for generating heat and power. There appears to be a 'neighbourhood effect', with initial adopters of biomass crops setting off a local chain reaction. It may also be possible to distinguish the factors that cause such crops to be clustered in particular areas, rather than being grown evenly across the landscape. These factors include motivations, ecology, hydrology, soils, proximity to markets, and government incentives.

3.10 The **Biodiverse Farming Project** is modelling economically-optimal actions and then asking farmers why they deviate from them. While maximising profit from the farm business was almost always the most important objective for the sample, other significant objectives included mitigating risks, maintaining the appearance of the farm, retaining autonomy and minimising business complexity. These motivations are not always taken fully into account in the design and delivery of policies to safeguard farmland biodiversity.

4. TACKLING LAND USE CHALLENGES AT SOURCE

4.1 The **Foresight Project** is exploring how tackling a land-related challenge at source rather than at an end point affects the relative costs and benefits to society. For example, should we require land managers to change how land is used to reduce nitrate pollution, or meet drinking water standards by requiring water companies to blend or treat the water? Some argue that farmers should bear the costs of treating polluted water (the damaging 'externality' should be 'internalised'). Others point out that this might require thousands of hectares of land to be withdrawn from agricultural production, with consequent impacts on food supplies and prices. Perhaps not surprisingly, current policies favour a mix of these two approaches.

4.2 'Tackling challenges at source' implies some disconnection between cause and effect, and between benefits and costs. It is important to be clear about whether the problems relate to the source, the pathway, the receptor, or a combination of these. For example, action at source to tackle flooding could include reducing stocking rates on upland pastures to reduce the soil compaction which leads to increased run-off, and in turn to soil erosion and flooding downstream. However, such action at source, while necessary, may not be sufficient; it may also be necessary to discourage building on floodplains. The **Floodplains Project** suggests that requiring land

managers to shoulder the entire burden of mitigating flood risk for the benefit of the new occupiers of houses on floodplains would be unfair. Moreover, it is unlikely that action by upland land managers alone would remove all flooding risks downstream, as recent surface water flooding in built up areas has demonstrated.

4.3 Recent policies for flood risk management have laid stress on working with natural processes. However, it should be recognised that this does not necessarily exclude engineering solutions. These could include modifications to upland landscapes to retain potential flood water, or creating washlands in floodplains that can be flooded or drained depending on need. Equally, the distinction is not simply between 'low-tech' and 'high-tech' approaches. For example, modern satellite technology underpins precision farming techniques which match fertiliser inputs to varying crop nutrient requirements across a field, thereby minimising wastage.

Tackling water pollution at source

4.4 The **Community Catchment Management Project** illustrates the benefits of tackling diverse sources of environmental problems at source through a coordinated project. It focuses on three issues: phosphate pollution of a lake linked to farming practices; the domestic use of detergents; and the management of private septic tanks. The Project has worked with all interested parties to encourage community understanding and ownership of the problem. A catchment-level survey of fertiliser needs has led three farmers to adjust the level of their nutrient inputs. This is reducing both their input costs and the regulatory pressures associated with phosphate levels in water. The Project has also spawned smaller community-led catchment studies of the domestic use of washing powders and of the condition of private septic tanks. The results will help local people take informed decisions about which washing products to use, and how to improve the functioning of septic tanks.

4.5 The **Sustainable Uplands Project** is examining the changes needed to secure better management of upland landscapes to deliver a wider range of ecosystem services. It is examining what incentives might lead to changes in management practices to help to reduce the costs of treating drinking water to remove the discoloration caused by eroded peat. In the absence of incentives, there is evidence that any future reduction in receipts from the Single Farm Payment would lead to a reduction in sheep numbers and an increase in burning. This might make the problem worse.

4.6 The **Catchment Management Project** is examining how to tackle diffuse water pollution at source, including changes in land use as well as in land management, the related governance needs, and the costs and benefits of alternative approaches. It draws on an analysis of international experience and investigation of two UK catchments. The UK case studies are observing and contrasting initiatives to protect water at source by a water company, a regional authority, and voluntary organisations such as Rivers Trusts.

4.7 The **Livestock Waste Project** has developed decision tools to help minimise transfers of pathogenic micro-organisms from livestock manure into rivers, with implications for the quality of drinking water and public health, and for regional industries dependent on clean water, including shellfisheries and seaside recreation. Options highlighted include implementing more low-cost and low-tech solutions (e.g. fencing off watercourses), and getting shellfish farmers to subsidise mitigation

measures put in place by livestock farmers.

Determining at what level to intervene

4.8 Work using the **Nutrition Project's** Land Use Allocation Model illustrates the interplay between policy action at source and at end point. A reference run of the Model predicted that the recent decoupling from production of support payments under the Common Agricultural Policy would lead to significant reductions in livestock numbers in the uplands, with impacts on economic and ecological services. The Project suggested that reintroducing some headage payments in these areas could halt, if not reverse, this decline in livestock grazing. Such a centralised policy change at 'source' would remove the need to develop alternative means to secure the lost services, such as agri-environment schemes or investment in tourism. France, for example, has retained the ability to provide headage payments of this sort in upland areas so as to prevent just this kind of problem developing.

ANNEX: 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 Traill, University of Reading **Email:** w.b.traill@reading.ac.uk

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

Recent flood events in Britain have heightened interest in exploring solutions that can join up multiple objectives such as managing flood risk, water resource management, enhanced biodiversity, enjoyment of the countryside, and support to rural livelihoods. The Project is addressing these issues and re-examining a selection of agricultural flood defence schemes, previously studied by the research team in the 1980s, to identify and explain changes in land and water management that have occurred over the last 40 years.
Contact Professor Joseph Morris, Cranfield University **Email:** j.morris@cranfield.ac.uk

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. It is 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, policy-makers 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, 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 Project 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