FORESIGHT LAND USE PROJECT

RELU FINDINGS

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CONTENTS

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30 July 2009

EXECUTIVE SUMMARY

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

Findings on governance and scale issues include:

1. Better communication and engagement is needed at all levels between all interested parties.
2. A more equitable relationship is needed, based on shared knowledge, among stakeholders.
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 is 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 actively seek out local initiatives which 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 means that varied and even 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 'relational' (i.e. they shift according to other social and political influences).
21. Farmers wrestle with internal conflicts: typically they want to be 'farmers', but they are also aware of, and would prefer to avoid, environmental risks associated with intensive farming.
22. A 'making do' mindset 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, and/or receptor.
28. Action 'at source', while necessary, may not be sufficient.
29. Working with natural processes does not necessarily 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 discolouration 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 which contribute to current discussions within the Foresight Land Use Project of the issues surrounding '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'. Those projects are listed in the Annex. I am very grateful for the valuable responses received, but take full responsibility for synthesising these.

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, nation). Evidence is sought on: decisions currently taken at 'inappropriate' scales, and/or with 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 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 what scope exists 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. They 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 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 greatly 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, will help build shared understanding. This will

also help satisfy what is seen as a critical need: to promote a more *equitable relationship*, based on shared knowledge, among relevant stakeholders.

Issues related to scale

2.6 Consideration of issues related to '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. For example, 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 by Natural England determining what management options to make available where (England/regional scale); and by the inputs, through consultation, of 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 scope, will largely have been determined at quite different spatial scales.

2.7 A governance framework focused on decisions made by individual farmers, which owes a great deal to the existing framework of private property rights, sits uneasily with an approach which seeks to deliver the full range of ecosystem services from 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 explores how, using the case of lowland floodplains, 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 to join 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 adopting 'blueprint' solutions. It suggests that governance processes are most effective when local interests are engaged from the outset in framing the problem and defining 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 practical implementation of a 'joined-up', integrated, multipurpose approach to land management based on an ecosystems approach. These barriers include:

- Established property/entitlement regimes (and legal frameworks) which serve dominant interests that focus on particular functions and outputs to the exclusion of others.
- Market failure associated with inadequate recognition of the type and value 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 operating 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 technologies.
- Reduced social capacity for collective and collaborative action, unless this 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 devised at a national level. The **Deer** project suggests that lack of coordination of diverse policies between different laws and institutions at a national scale frustrates effective local action to manage wild deer herds. It also suggests that it cannot be assumed that national collaboration between Government agencies, voluntary bodies and land manager representatives will necessarily be replicated at local levels: lack of local communication, understanding or respect may be significant barriers. The project stresses the need for two-way 'top-down' and 'bottom-up' 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 effectively into national-level policies and plans.

2.13 The **Community Catchment Management** project indicates that working across institutional boundaries is difficult, especially if this is not an established practice for institutions and communities. Bureaucracy is a barrier from both perspectives: it 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 necessarily be lost, and new responsibilities 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 actively seek out local initiatives which may need support, and should identify and promote relevant precedents as models 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, 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 through *group* agreements? Few schemes reward farmers for viewing land management issues as a group, developing a consensus, and delivering collaborative action (from their own initiative and/or through peer pressure). The **Community Catchment Management** project suggests that there are opportunities to learn from precedents: examples of existing group agreements (e.g. for the management of common land grazing); and evidence of historical neighbourhood cooperation (which shows that even the most individualistic farmers will work together at specific times).

Further projects considering spatial issues

2.16 The **Organic** project focuses on the spatial pattern of the 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. However, data on impacts tend to be largely collected and experienced at field scale. The impacts depend on (among other factors) the size and distribution of power plants supplied by the crops (which can require either local or regional supply of biomass fuel). The project brings all the different scales together in determining 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: markets (fluctuations in prices and costs); policy (both explicit agricultural Directives and those from a range of concerns which indirectly impinge upon land use, such as the Water Framework Directive); and the environment (both cross-sectional variation across 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. There is a particular interest in understanding how the delivery of desired policy outcomes is affected by the diverse motivations of land managers. Their heterogeneity means that varied and even unexpected responses to policy interventions should be expected. While the unpredictability of the responses of land managers poses a challenge for policy-makers, it also presents 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 at various spatial scales.

The nature of motivations

3.2 It is well-known that land managers are a diverse group. They include agribusinesses, family farms, businesses focused on niche markets, contractors, ‘lifestyle’ entrants, foresters, equine enterprises, voluntary bodies, water companies, and, not least, the state itself. The ‘fourth-generation family farm producing basic commodities’ is not typical. This heterogeneity is also 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 other social and political influences) and need to be viewed as social, not just individual, phenomena. In particular, the project has noted the 'making do' mindset of farmers in the study catchment. While this partly reflects a lack of motivation to innovate, it also reflects legitimate scepticism about being constantly pressured into 'new practices' that do not seem to make things any better, and a concern that innovation can increases risks in farming businesses which in any case 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: typically they want to be 'farmers', but they are also aware of, and would prefer to avoid, the environmental risks associated with the types of intensive farming regimes which have been encouraged by policy and/or are necessary to ensure the financial viability of their businesses. The project has also found some confusion, given 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 government 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 be best structured and delivered to achieve behavioural change, mutually-beneficial outcomes and multiple objectives. In particular, the project points to the importance of access to farm-level analytical and advisory support, from locally-based and trusted 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 employed on low-cost, short-term contracts. The project suggests that the necessary 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, and/or incentives were available. The project recommends a collaborative approach in realising both public and private objectives for hill land. This needs to be flexible, to adapt to change, and to involve land managers, as well as local people and public bodies, in developing strategies and plans. This approach will be important not only for resolving conflicts between traditional ecosystem services (e.g. hunting, farming and biodiversity) but also 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 to be preferred as the mechanism by which to encourage further collaboration in deer management.

3.7 The **Catchment Management** project reports on the formation of several 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; for example, the Environment Agency uses the Anglian groups to focus dialogue about managing irrigation water. Such *community-based* approaches contrast 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 these to simulate how profit-maximising farmers would respond to changes such as decoupling, 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 across 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 role played by diverse factors in causing such crops to be clustered in particular areas, rather than spread evenly across the landscape. The 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 risk mitigation, appearance of the farm, autonomy and business complexity. These motivations are not necessarily taken fully into account in the design and delivery of policy instruments (e.g. to secure targets for safeguarding farmland bird populations).

4. TACKLING LAND-USE CHALLENGES AT SOURCE

4.1 The Foresight Project is exploring whether tackling a land-related challenge at source rather than at an end-point significantly reduces costs to society or increases benefits. For example, there has been a long-standing debate about the relative merits of (a) requiring land managers to change how land is used and managed to reduce pollution of drinking water supplies by nitrate, or (b) ensuring that drinking water standards are met by blending or treating water at water-treatment works. Some argue that farmers should bear the costs of treating water polluted by farming activities (the damaging 'externality' should be 'internalised'). Others point out that doing so might actually require thousands of hectares of land to be withdrawn entirely from 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, pathway, and/or receptor. 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 then flooding downstream. However, such action 'at source', while *necessary*, may not be *sufficient*; hence 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 within built-up areas themselves has demonstrated.

4.3 There has been a strong emphasis within recent policies for flood risk management 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 the use of precision farming techniques to 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 phosphate pollution of a lake linked to farming practices, 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. Hence 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 domestic use of washing powders, and 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 discolouration 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 in turn lead to further increases in the discolouration of water.

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, drawing 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 (e.g. 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 regional industries dependent on clean water (including shellfisheries and seaside recreation). Specific 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 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 consequent 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 alternatives means (e.g. via agri-environment schemes and aid for tourism) to secure (at 'end-point') the lost services. Interestingly, some other EU countries (e.g. France) have retained the ability to provide headage payments of this sort in upland areas (there was an option to do so), to prevent just this kind of problem developing.

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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. 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 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