

RELU food chain research: Implications for policy

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An independent report to the RELU
programme by Tom MacMillan

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1 Introduction: the food chain and the rural economy

Our food chain is rooted in the land and the rural economy. It seems obvious but we easily forget. After all, we can grow vegetables without soil, fly chickens by jet and move production and processing from continent to continent.

Yet, the link between food and rural places is becoming more prominent in policy and in the marketplace. We have seen a push to 'reconnect', called for by the Curry Commission after the 2001 foot and mouth disease outbreak, built into government strategies for sustainable farming and food, and reflected in steep sales growth for local foods. Now rising meat prices remind us that animals eat grain grown in real places with harvests subject to the vagaries of the weather.

The Rural Economy and Land Use (RELU) programme was set up to explore such connections through groundbreaking interdisciplinary research. Jointly funded by three UK research councils with a starting budget of £24 million, it has had biologists working with historians, political scientists with ecologists, economists with hydrologists, pioneering new research that supports sustainable rural development¹.

The first wave of RELU projects focused on sustainable food chains. The programme funded seven projects that confront the headline problems faced by the food chain – climate change, biodiversity loss, nutrition and food safety – and ask how the countryside will respond. Can we change the way we use land to help tackle these problems? How can rural communities and economies thrive on this change? The last of these projects will end late in 2008 and each will publish its own findings for research and for policy around issues such as food miles, healthy eating and pesticide use.

This report is about the *cross-cutting* policy implications of the seven food chain projects. As a set, they raise broader issues for how policy approaches the connections between food, the rural economy and land use. They prompt

¹ Lowe, P. and Phillipson, J. (2006) Reflexive interdisciplinary research: the making of an interdisciplinary research programme on the rural economy and land use. *Journal of Agricultural Economics*, 57(2), 165-184.

us to rethink three key objectives of government policies on farming and food, and the part the government should play in meeting those goals:

- A healthy food chain – policies to change land use can promote public health.
- Economic and ecological diversity – government can help producers, consumers and regulators diversify in ways that treat natural variation as an opportunity, not just something that poses a risk or is at risk.
- Dynamic rural economies – policies to promote rural innovation should focus more on people, markets and government than on products and how they are produced.
- How to govern – interdisciplinary research challenges what three policy buzz-words – choice, evidence and joining-up – actually entail.

2 The projects

Farming health

Implications of a Nutrition Driven Food Policy for the Countryside

Principal investigator: Bruce Traill, University of Reading

www.relu.ac.uk/research/projects/Traill.htm

Reforms to Europe's Common Agricultural Policy are expected to leave UK farming more exposed to market forces. Meanwhile, in the marketplace, health is a growing concern as policy makers, food companies and consumers worry about the consequences of poor diets and how to eat more healthily. How might dietary change affect the rural economy and landscape? What would the countryside look like if we all ate our 'five-a-day'? Will we rely on imports and exports to meet any changes in demand? What difference would it make if farmers could produce healthier versions of the meat, fruit and vegetables that we are used to? Are there win-win situations in which food produced in environmentally friendly systems can provide health benefits? How much are consumers prepared to pay for healthier food? To what extent do healthiness, locality and production systems contribute to consumers' perceptions of food quality?

The *Farming Health* project studies how different production systems influence the healthiness of ruminant meat and soft fruit and lettuce, and how these products are perceived and valued by consumers. It models the effects of different healthy eating patterns and policy scenarios on the rural economy, biodiversity and the landscape.

Eating biodiversity

Realising the Links between Quality Food Production and Biodiversity Protection

Principal investigator: Henry Buller, University of Exeter

Other institutions: University of Bristol, University of Gloucestershire, Institute of Grassland and Environmental Research

www.relu.ac.uk/research/projects/Buller.htm

Policies on land use, farming and conservation recognise the need to protect biodiversity. In ecologically sensitive areas, this may mean restricting agriculture, for instance by placing limits on grazing. But is grazing always so bad? In some ecosystems, such as saltmarshes and moorlands, can it actually support biodiversity? What about the meat and dairy products from biodiverse pastures? Can you taste the difference? Are they better for you? If there are any benefits, would consumers pay more for them?

The *Eating Biodiversity* project looks at situations where biodiversity is an asset to production rather than just an add-on. The team explores the links between the chemical qualities of food, consumer perceptions, animal diet and biodiversity. Using case studies, they consider the practical implications for land use and farm businesses.

Tropical fish

Warmwater Fish Production as a Diversification Strategy for Arable Farmers

Principal investigator: David Little, University of Stirling

www.relu.ac.uk/research/projects/Little.htm

Most people in the UK eat less fish than nutritionists advise. Yet almost half the fish eaten world-wide are now farmed. Fish farming can wreak a heavy toll on the environment through overfishing for wild species to feed the captive fish and through pollution, so eating more could be unsustainable. There are health concerns too, because carnivorous fish can accumulate high levels of poisonous metals such as mercury. Tilapia is a fish that avoids some of these problems because it feeds low down the food chain. The only hitch is that tilapia is a warmwater fish, more used to the tropics than to the UK.

The *Tropical Fish* team is developing systems for farming tilapia sustainably using waste heat and spare buildings on UK farms. They see tilapia farming as a promising way for arable and livestock farmers to diversify. As well as devising technical guidance, they are researching the market and consumers' appetites for locally-sourced tilapia.

Local food

Comparative Merits of Consuming Vegetables Produced Locally and Overseas

Principal investigator: Gareth Edwards-Jones, University of Wales, Bangor

Other institutions: Centre for Ecology and Hydrology, University of Surrey

www.relu.ac.uk/research/projects/Edwards-Jones.htm

'Food miles' has become a shorthand for sustainability. However, study after study has shown that there is more to our food's climate change impact than the distance it has travelled. Production, particularly the use of synthetic fertilisers, and even cooking in the home, can account for a big share of emissions. It gets yet more complicated when we consider health, the economy and other issues tied up with sustainable development. Is it better to fly in fresh food from Africa than to get it from down the road, even if it does use more energy, because it helps fight global poverty?

The *Local Food* project takes a systematic approach to assessing the pros and cons of 'local food', comparing case studies of vegetables for the UK market grown in the UK, Spain and Uganda. It strengthens the evidence-base on greenhouse gas emissions, taking into account soil emissions that are usually left out of Life Cycle Assessment. The team evaluates the health of workers, the nutritional quality of food, local employment and the cultural values.

Biopesticides

The Role of Regulation in Developing Biological Alternatives to Pesticides

Principal investigator: Wyn Grant, University of Warwick

www.relu.ac.uk/research/projects/Grant.htm

Farmers and growers are under pressure to use fewer synthetic pesticides. This is partly for environmental reasons, but also because concerns about the health of workers, bystanders and consumers persist in spite of assurances by regulators. In practice, the pressure to reduce pesticide use often comes from supermarkets, which have tight standards on pesticide residues that go beyond legal requirements. The problem farmers and growers face is to meet these standards at the same time as meeting other demands from supermarket buyers, for disease-free, good-looking produce at low prices.

The *Biopesticides* project explores how 'biological control agents' could help. They are organisms such as fungi, bacteria, viruses or nematodes that protect crops against pests, diseases and weeds. The advantages that the project team see in these 'biopesticides'

include their low-impact on non-target organisms and limited toxic residues. Yet few are on the market. One barrier is that the regulatory system has been built around chemical pesticides, and the cost for biopesticides of jumping through the same hoops is prohibitively high. The project proposes reforms to the regulatory system that would help sustainable pest control methods get on the market while ensuring public safety.

Livestock waste

Sustainable and Safe Recycling of Livestock Waste

Principal investigator: Dave Chadwick, Institute of Grassland and Environmental Research

Other institutions: University of Exeter, Lancaster University

www.relu.ac.uk/research/projects/Chadwick.htm

Some 90 million tonnes of livestock manure are produced each year in the UK. The majority of this is stored and then spread back onto the land as fertiliser. As well as being a vast resource of plant nutrients and organic matter, manure can pose problems if it is applied at the wrong rate or time of year. In particular, it can pollute water courses, not just with nutrients like nitrogen and phosphorus but also with pathogens that can cause diseases in people. Microbial pollution from livestock manure can pollute crops like lettuce through irrigation with contaminated water, causing food poisoning, it can close down coastal shell fisheries and it can see red flags hoisted on popular holiday beaches. Although advice is available, there is little direct incentive for farmers to manage this risk because the pollution is diffuse.

The *Livestock Waste* team ask how farmers can manage manure and livestock in ways that reduce the risk of microbial pollution. They study how long faecal indicator organisms survive in manure and how they end up in water, and map the risks of microbial transfers from different fields and steadings at different times on livestock farms. They also consider the human dimension: who should be responsible for managing this risk, and what sticks and carrots would help them to do so?

Food risk

Managing Food Chain Risks

Principal investigator: Richard Shepherd, University of Surrey

Other institutions: Central Science Laboratory, Institute of Food Research, Leeds University, University of Manchester

<http://www.relu.ac.uk/research/projects/Shepherd.htm>

A sustainable food system must be resilient to shocks. The 2001 foot and mouth disease outbreak cost the farming industry £500 million a year in lost exports, for instance, which amounts to more than the annual total spent on rural development. We also need to consider the wider knock-on effects: the same outbreak is estimated to have cost the tourist industry a staggering £5.2 billion in 2001 and led to 150,000 job losses².

The *Food Risk* project argues that opening up risk and crisis management to a wider range of people – not just technical experts in that risk but also stakeholders such as people living in

² Ward, N., Donaldson, A., and Lowe, P. (2004) Policy framing and learning the lessons from the UK's foot and mouth disease crisis. *Environment and Planning C-Government and Policy* **22** (2), 291-306.

rural communities – can help risk managers take these wider consequences into account. These ‘outsiders’ can bring new knowledge to the attention of risk managers and test risk management assumptions. However, they do not always talk the same language as risk managers. The project is developing ways for risk managers and stakeholders to communicate with each other about food chain risks.

3 Healthy

By 2010, around a third of UK adults and a fifth of children will be obese, facing a higher risk of heart disease, strokes, diabetes and some cancers³. What we eat plays a big part in this.

Addressing this problem could have implications for land use, depending how much food we import and export. Government recognises this. The *Strategy for Sustainable Farming and Food* says that support for farming is about helping to ensure agriculture provides public benefits not just by looking after the landscape, but also by helping to meet consumer demands for healthy food⁴. It is seen as good thing for health to drive land use.

Food affects our health in other ways besides nutrition. The policy approach is similar when it comes to food safety and the health of workers. Both are seen as issues that extend right the way along the food chain and that, if properly addressed, could have knock on effects for land use.

The RELU food chain projects explore the connection between health and land use. They help us understand how far health demands actually drive land use. But they also go a step further: they challenge us to consider how changing land use – and the policies that shape it – might help drive better health.

³ Wanless, D., Appleby, J., Harrison, A., and Patel, D. (2007) *Our future health secured: a review of NHS funding and performance*. King's Fund, London. www.kingsfund.org.uk/document.rm?id=7129

⁴ Defra (2002) *Strategy for sustainable farming and food: facing the future*. Defra, London. <http://www.defra.gov.uk/farm/policy/sustain/pdf/sffs.pdf>

Nutrition

If everyone in the UK ate a healthy diet in line with World Health Organisation or Department of Health guidelines, we would consume 50% more fruit and vegetables and 75% less cheese. This leads the *Farming Health* project to explore what drives healthy eating in practice and to ask how well changes in consumer demand feed along the food chain to reshape land use. How would consumers react to public health interventions like advertising campaigns or a fat tax? How well does agriculture respond to changes in end consumer demand, given the mediating influences of farm policy and supply-chain governance?

The project also explores the potential for producing healthier versions of traditional food products through changes in husbandry. Can the fatty acid profile of lamb be improved by grazing on biodiverse pastures? Will health-protecting phytochemical levels in soft fruit and lettuce be augmented by growing under UV-transparent rather than traditional plastic? And, crucially, will consumers pay more for healthier versions of these foods?

The findings so far suggest that consumers are indeed prepared to pay substantially more for healthier lamb, strawberries and lettuce. The project's economic models will try to take into account consumers' preferences for different foods and the value they place on health, buying local or British food compared with food from elsewhere. Is healthy eating actually being held back by the local availability of healthy food?

The *Farming Health* project found that biodiverse pastures yielded a healthier fatty-acid profile. Similarly, the *Eating Biodiversity* team compared beef, lamb and cheese produced on species-rich moorland, heaths and saltmarshes with that produced on ryegrass pasture. In lamb, for example, they found higher levels of vitamin E and a healthier fatty acid profile on the more diverse grazing land.

While the *Farming Health* project models the effects on land use of different food demand scenarios, the *Local Food* team asks how different supply-chain scenarios would affect nutrition and the environment. Is local food better for us? The *Local Food* project's chemical analysis shows that, in season, local produce may be fresher and healthier. Out of season it is often not, since nutrient loss is higher during long-term storage than long-distance transit.

While the nutritional benefits of eating fresher produce may be marginal, according to the *Local Food* team, produce that is in season locally generally has a low environmental footprint. Promoting a seasonal five-a-day could be good for our health and the planet. But, as the *Farming Health* team argue, there are limits to how far demand-side measures are likely to reap this double-dividend. So, could support for land managers promote healthy eating – say by helping lamb producers convert to grazing that yields a healthier fat profile? Or would a supply-side approach mean we end up just exporting healthier products without changing diets in the UK?

As a nation we need to eat more healthily and eating local produce in season is one of the most sustainable ways to do so. But supporting production would not necessarily boost consumption. Stimulating consumer demand could involve supporting assurance schemes as well as working with the supply chain to promote fresh produce consumption and 'five-a-day' messages.

Policy proposal: use Common Agricultural Policy funds to build consumer demand for a seasonal five-a-day.

Food safety

The government's attitude to food safety is different from its approach to nutrition – while nutritious food is expected to be readily available and easy to choose, the aspiration is that all food should be safe. However, the UK suffers an estimated 860,000 cases of food poisoning each year, costing up to £1.5 billion⁵. The *Livestock Waste* project focuses on how land use changes can help manage the risk of water becoming contaminated with livestock derived faecal indicator organisms. Contamination not only poses a risk to bathers, when the rivers running through fields eventually wash into the sea, but also to people eating shellfish and irrigated vegetables such as lettuce.

The project finds that, drawing on a science-based risk framework, farmers can manage manure and livestock in ways that markedly reduce the risk of contaminating water, shellfish and irrigated foods. The factors include how and when manure is applied to land, how effluent from the farmyard is contained, and where and when livestock graze and access drinking water. The technical challenge is to map general rules about risks onto real farms and real catchments. The policy challenge is to make it worth farmers' while to help reduce a diffuse risk.

While the *Livestock Waste* project shows that land use can sometimes be the crucial issue in risk management, the *Food Risk* team explores a case where the potential for risk management is distributed more evenly along the supply chain. They consider campylobacter, one of the commonest causes of food poisoning. While risks can be reduced in production and processing they cannot be eliminated, so consumers will need to play an active role as long as they eat the products at risk of contamination – in this case cooking meat in line with food safety advice – to keep the incidence of poisoning down.

When the *Food Risk* team asked stakeholders to map the food system, they were struck not just by how complex supply-chains are, but by how undifferentiated and untraceable they become at certain points along the journey from raw commodity to finished product. Ingredients even for simple processed foods are bought in bulk on world commodity markets and manufacturers may use palm oil one week then seed oils the next, say, depending on prices.

This feature of the food system makes it vulnerable to shocks. In 2005, the illegal use of Sudan-1 as a colorant in one brand of Worcestershire sauce led to the withdrawal of 580 products that used the sauce as an ingredient. In that case, complexity and differentiation across a wide range of products hid a lack of diversity in food ingredients.

So, while many factors besides land use contribute to food contamination, policies affecting land use can offer an important way to intervene. In the absence of any comebacks or clear liabilities from polluting water sources with manure, could farm support provide incentives and extension services that encourage responsible manure management? Would rural development measures to promote shorter supply chains reduce the number of people affected by food poisoning outbreaks, even if it did not change the occurrence of outbreaks?

Policy proposal: assess the public benefit from reduced disease incidence of public investment in infrastructure and marketing to promote shorter supply chains.

⁵ Food Standards Agency (2006) *Research and survey programmes: annual report 2006*. FSA, London. <http://www.food.gov.uk/multimedia/pdfs/annualscirep>

Workers

When we talk about a healthy food chain we usually think about consumers. However, farm workers face the worst fatal injury rate of any major employment sector. In 2006, 45 deaths were recorded in the UK and 400,000 working days were lost to illness and injury⁶. Making the food chain a safe and healthy place to work is an explicit objective of the government's *Strategy for Sustainable Farming and Food*.

The RELU food chain projects highlight that, even where employers provide for workers' basic legal rights, worker health can be poor. The *Local Food* team found that the health of workers on the UK farms they studied deteriorated significantly over the growing season. None of the workers were English and most came from Eastern Europe. All were surveyed using internationally recognised health questionnaires.

Such a rapid decline in the health of legally employed workers raises fundamental questions about the level of protection provided by law. Are employment rights for temporary workers inadequate? Is exploitation taking place, even where workers are legal and consenting?

Yet it is the two comparative elements of the *Local Food* study that are most crucial for land use. First, they compared workers on conventional and organic farms. There was no significant difference in their physical health but the workers on organic farms reported being happier. The researchers put this down to the greater variation in their work.

The *Local Food* project also compared workers in the UK with workers in Uganda. Taking into account base-line differences in health between the two countries, researchers found that the workers in Uganda started *and ended* the survey in good health. The simple message is that buying food from poorer countries can provide tangible social benefits. But what is the appropriate policy response? Would it be better to encourage people to grow less food in the UK and buy from Uganda instead, in order to improve the health of Ugandans? Or should we improve working conditions for people working in the industry in the UK? Alternatively, should we do both?

Policy proposal: grant temporary workers the same rights as permanent staff and explore the win-wins from mixed farming for the wellbeing of both workers and the environment.

⁶ Health and Safety Commission and Executive Agriculture Industry Advisory Committee (2006) *Migrant workers: injury and ill health statistics in agriculture*. HSE, London. <http://www.hse.gov.uk/aboutus/hsc/iacs/aiac/290606/aiac290601.pdf>. Health and Safety Executive (2006) *Fatal injuries report 2005/06 and HSE's priorities for farming*. <http://www.hse.gov.uk/agriculture/fatal.htm>. Health and Safety Executive (2006) *Working days lost by industry 2004/05*. <http://www.hse.gov.uk/statistics/tables/0405/wdind.htm>. All cited in Pollitzer, F (2007) Vital statistics. *Food Ethics* 2 (2), 13.

4 Diverse

UK policies around food, farming and rural development see diversity as a strength. Diversification is seen as vital to the viability of the farm businesses and the rural economy⁷. Ecological and biological diversity is valued as a source and sign of a healthy environment. Healthy eating advice still points us towards the old adage of 'a good mixed diet'. And diverse stakeholders are encouraged to take part in decision-making, as a way of increasing the quality and accountability of decisions.

The food chain projects reinforce this message. Yet they also invite us to make more of the interplay between economic and ecological diversity. They show that production can support biodiversity, not just threaten it. They explore whether consumers could value seasonal variation – diversity over time – as much as a year-round range of fresh produce. They show that the complexity of real world food systems calls for diverse stakeholders to be involved in risk management, not just day-to-day but even in crises.

⁷ Hampson, S (2006) Differentiation: a sustainable future for UK agriculture. Royal Agricultural Society of England, Stoneleigh.

Production

Rural areas are more than farmland and farms are used for more than agricultural production. While agriculture accounts for 86% of rural land in the UK⁸, it employs only 2.6% of the rural workforce⁹. Diversification has been a way for farm businesses to remain solvent during a period of falling farm-gate prices and farm subsidy reform¹⁰. It is often taken to mean using farm resources to make money outside of agriculture.

However, diversification is not just about moving out of agriculture. When farmers move into new markets such as biofuels that can also be referred to as diversification. Two RELU projects focus on diversification strategies that offer the best of both worlds, using farm resources in new ways while also producing higher value food for new markets.

The *Tropical Fish* project explores whether it is viable for farmers to grow tilapia, a tropical fish, on a small scale alongside more traditional agricultural activities. The project finds it to be a realistic way for farmers to supplement their income, making use of waste heat and spare buildings.

The *Eating Biodiversity* case study of saltmarsh lamb looks just like an example of agricultural diversification, where farmers are boosting their earnings with a high-value niche product. Yet it is about diversifying conservation as well as agriculture, out of being a protective land use into being a productive one. It challenges an 'either-or' view of farming and nature conservation, to find ways we can do both at once off the very same land.

In the *Eating Biodiversity* project economic diversity and biodiversity are closely connected. Biodiversity is central to sustainable development: the variety of species, genotypes and ecosystems underpins and indicates the vitality of the natural environment¹¹. What the project shows is that it biodiverse farming systems can also produce tastier, healthier, higher-value products within a differentiated market.

So everyone wins. Consumers get a better product, farmers can get a better price and the biodiversity is valued as input to production, not just an adjunct to it. Biodiversity comes out of the field margins, into the field¹². In contrast to most environmental stewardship schemes, where food is grown in one spot and nature in another, production and conservation are integrated.

The market is driving some meat producers down this route, but policy could make it easier. Rural development support could mitigate the high-risks and limited access to markets that put farmers off converting to high-quality extensive production, extending the area under biodiverse pasture to new unprotected land. Conversely, opening up protected land to well-managed grazing could benefit the landscape and biodiversity, as well as generating income to support conservation.

⁸ Defra (2006) *Key facts about land use and land cover*.

<http://www.defra.gov.uk/environment/statistics/land/kf/ldkf08.htm>

⁹ Donaldson, A., Lee, R., Ward, N. and Wilkinson, K. (2006) Foot and mouth – five years on: the legacy of the 2001 foot and mouth disease crisis for farming and the British countryside. Centre for Rural Economy Discussion Paper Series No. 6. <http://www.ncl.ac.uk/press.office/press.release/content.phtml?ref=1140428463>

¹⁰ Defra and National Statistics (2007) *Farm diversification – January 2007*. <http://statistics.defra.gov.uk/esg/reports/divagri.pdf>

¹¹ Defra (2007) *Valuing the benefits of biodiversity*. <http://www.defra.gov.uk/wildlife-countryside/pdfs/biodiversity/econ-bene-biodiversity.pdf>

¹² Gail Vine in Green Futures quoting Lynne Kenderline, Devon Wildlife Trust.

For now, these projects suggest ways we could get more for public money. If there is a good business case to produce food from waste heat or to conserve biodiversity, taxpayers can divert farm support towards other rural development priorities instead. But as food and fuel prices rise, the tables may turn. Environmental stewardship payments may become less important to farm businesses and their leverage may diminish. In that case, the race will be on to find more ways, like these, for farmers to profit from production that benefits the environment.

Policy proposal: review how much grazing is permitted in sensitive ecosystems, while ensuring that protection for such areas is not downgraded.

Consumption

We know the health reasons for eating a varied diet. The RELU projects show there may be quality and environmental reasons too. The *Eating Biodiversity* project finds that just as biodiversity and plant species vary from place to place, so does the taste and quality of meat and dairy products.

The project team speculate that this may explain the French concept of 'terroir', which links the qualities of foods to particular geographical locations. In terms of quality, they argue, it is the locality (where food is produced), not localness (how close it was produced), that matters.

Yet the point is not simply that some places may produce better quality foods than others. Rather, distinctiveness may itself be considered a mark of quality. The *Eating Biodiversity* project drew on previous research about cheese in France, where distinctiveness is highly prized.

While the project's taste panels and chemical analyses attest to the quality of the 'biodiverse' meat against widely used standards, the value of products such as saltmarsh lamb is also associated with more subjective qualities, in particular their authenticity as 'natural' products. Yet here, too, variation is crucial. That the characteristics of a product vary from season to season or year to year is valued as an indicator of 'naturalness' in high-end markets. Consistent product characteristics are seen to mark a product out as 'artificial' and 'bland'.

Trying to marry public health and environmental priorities, the *Local Food* project is concerned with mass markets, not niche products. Yet this team's work, too, considers how consumers value diversity in their diets. This is because the environmental footprint of food varies depending on where and when it is produced.

So, the climate impact of a lettuce or potato can vary markedly from place to place – from field to field, not just continent to continent. Production methods can be a major factor but so too can the type of soil. Initial comparisons suggest that UK soils are losing carbon at one-third the rate of industrial emissions and 13 times the rate of emissions from food imports. These emissions can be reduced through changes to land management.

The *Local Food* team also finds significant seasonal variation in emissions from producing and storing food. In a parallel piece of research, members of the project team discovered that the energy embodied in an English apple rises steadily from harvest time over the year because of storage costs, to a point where, by mid-summer, it may be better for the climate to ship them in from the southern hemisphere¹³. Likewise, in summer, it is better for the climate

¹³ Milà i Canals, L, Cowell, J, Sim, S, and Basson, L (2007) Comparing domestic versus imported apples: a focus on energy use. *Env Sci Pollut Res* 14 (5), 338–344.

for UK consumers to get tomatoes from England than from Spain. In winter, though, the Spanish tomatoes win.

But the challenge is not just to compare like with like. Consumers, retailers and policy-makers face a tougher question. Can we afford to eat fresh tomatoes in winter from Spain or from heated greenhouses in England, given their contribution to climate change? The same goes for many other out-of-season fruits and vegetables.

In terms of public health and wellbeing, can we afford not to? What would our 'five-a-day' look like if we ate fruit and vegetables that were in season locally? Would consumers see seasonal eating as an unwelcome throwback, or could we value greater seasonal variation in our diet as much as we value having a diversity of food choices at any single time?

Policy proposal: work with retailers to highlight consumer benefits from natural variations in food products and availability, for example building on recent initiatives to sell 'ugly fruit'.

Regulation

The *Food Risk* project calls for greater diversity in regulation, involving a wider range of people in decision-making. The case for involving stakeholders and the public in policy formation is well established in principle within government and numerous initiatives now exist to turn that aspiration into practice. The *Food Risk* work is different because it asks whether participation can be an asset during risk and crisis management – is there really any benefit when time is of the essence?

The project argues that risk and crisis management processes can be stronger for reflecting the real-world complexity of food systems, involving a diversity of experts and stakeholders from outside the risk management community, such as campaigners, farmers, rural businesses and social scientists. Enabling people with relevant non-technical knowledge to contribute can help risk managers consider the practical implications of different risk management options. It can also help decision-makers to see the problems they face in new light. The *Livestock Waste* project endorses this approach, running a citizens' jury to explore how the microbial contamination risks associated with manure should be handled.

Working with professional risk managers in the Food Standards Agency and the Pesticides Safety Directorate, the *Food Risk* project has debated and simulated chemical and disease risk scenarios. It has found a strong appetite among risk managers for exploring with stakeholders how different decisions might play out in practice.

Getting more people involved in risk and crisis management poses practical challenges. In particular, different stakeholder and expert groups use different language to talk about the food system. To help participants create shared reference points for discussions about risk management, the project has developed an IT programme where users can map the food system as if they were using 'fuzzy felt'.

Involving and engaging with stakeholders can strengthen the evidence-base for risk management. But that is not all. As the *Food Risk* team point out, the complexity of the food system limits how far government can directly mitigate risks and crises.

Policy proposal: make stakeholder engagement a default feature of crisis management protocols.

5 Dynamic

The Curry Commission called for farming and food to play “a dynamic role in the rural economy”¹⁴. Government has responded with initiatives to promote innovation and entrepreneurship.

The RELU projects share this enthusiasm. After all, innovation is how we respond to new challenges and opportunities. Without innovation, we cannot have a sustainable food system or a thriving rural economy.

Every one of the RELU food chain projects touches on innovation. The *Tropical Fish*, *Eating Biodiversity* and *Farming Health* projects explore the potential benefits and costs of new ways of producing and marketing food, for producers, for health and for the environment. The first focuses on making small-scale fish-farming an option for farmers, while the other two examine grazing and horticultural practices that boost the nutritional quality of meat, fruit and vegetables.

The *Local Food* and *Livestock Waste* projects look at how to drive innovation, on farms and within the supply-chain, that will benefit public health and the environment. The *Biopesticides* project addresses the regulatory barriers to innovation in pest control and, like the *Food Risk* work on risk management, also considers how regulatory bodies can innovate.

Taken together, they challenge how we think about innovation and policy efforts to promote it. Who innovates and why? What are the main barriers they face? How can rural communities thrive off change, not be blighted by it? They suggest that policies to promote rural innovation should focus more on entrepreneurs, markets and regulation than on products and how they are produced.

¹⁴ Defra (2002) Strategy for sustainable farming and food: facing the future. Defra, London: 10. <http://www.defra.gov.uk/farm/policy/sustain/pdf/sffs.pdf>

People

The *Eating Biodiversity* and *Tropical Fish* projects focus on relatively small-scale sustainable production and quality niche marketing. They both recognise that individual entrepreneurs play a vital role in innovation and explore who these people are. Their case studies might be considered 'alternative food networks' or examples of 'ecological entrepreneurship' – food chain innovation that delivers clear public goods..

The meat and dairy products studied by the *Eating Biodiversity* team receive a premium linked to their authenticity as 'natural' products. Yet, while many of the entrepreneurs they interviewed are passionate about ecological farming, they started farming this way because it was good business above all else. Many of the producers the project contacted were first generation farmers, often with business experience, and often from cities.

The *Tropical Fish* project finds that some households moving into small-scale tilapia production are not rural at all, but make use of spare buildings in peri-urban areas. The project discovers that people already involved in tilapia production in the UK, or thinking of moving into it, have many different reasons for doing so. Some are serial entrepreneurs. Some are large estates that treat tilapia as one of a portfolio of diversification strategies. Others are desperate for income to save their farm businesses. People's lifestyles matter – in profiling potential tilapia producers, one of the major factors the team considers is how well the practicalities of looking after this new kind of livestock will suit the lifestyles of would-be entrepreneurs.

All this has implications for how policy can reap the double-dividend of promoting green innovation in the food chain. A dynamic farming sector needs a mix of old and new skills, including farming know-how, business nous and good knowledge of markets and consumer trends. Schemes to encourage new entrants to sustainable farming, targeting urban as well as rural audiences, could contribute to this mix.

Policy proposal: work with Regional Development Agencies to create incentives for new entrants to farming and to enhance business skills in the sector.

Businesses

We often think of innovation as the process of inventing new products or technology. That is part of it, but by no means all. The food chain projects examine the barriers to businesses adopting innovative production systems that are in the wider public interest, and the secrets of success.

They find three main obstacles – and only one relates to product development. The first is that the balance of costs and benefits, or uncertainty about them, is often not favourable enough for potential entrepreneurs. In the *Eating Biodiversity* study of saltmarsh lamb, the uncertainty facing producers entering a new market means that many have standard production systems to underpin their high-value operations. In the case of tilapia, the uncertainty of producing and marketing a completely new product is off-putting for some producers but, for serial entrepreneurs, it is actually the relatively low risk coupled with low return that is a deterrent.

Second, the systems that supermarkets and other big players use to manage their supply chains can stifle innovation. The *Biopesticides* project notes that supermarkets' supply-chain management standards are often stricter than the law when it comes to pesticide use. Yet the retailers' zero-tolerance approach towards pesticide residues does not actively encourage

producers to adopt biological control measures that might meet environmental and health goals while also helping to limit plant disease. Private sector governance systems can hold back innovation that could be in the public interest.

The *Local Food* team have a similar concern about the carbon labels being introduced by food manufacturers and retailers. Footprinting that standardises environmental impacts, so that a consistent label can be placed on the same branded product wherever the ingredients come from and however it is actually produced, gives producers little incentive for green innovation. By contrast, actually measuring performance, rather than averaging it out, creates a basis for rewarding and motivating improvement.

Third, the *Biopesticides* team laments the lack of state support for new pest control products that would deliver environmental and social benefits. More could be done without infringing the limits placed on state aid under EU rules.

How could policy address these barriers? Perhaps government should provide more conversion support to help offset the costs and risks of adopting greener production systems. Perhaps regulators should work more closely with retailers to ‘proof’ supply-chain management for any dampening effect on innovation. And maybe we should be more active in supporting research and product development in the public interest where the market is weak, even if it has not strictly ‘failed’.

As for the success stories, the *Eating Biodiversity* and *Tropical Fish* projects both find that access to the right markets was crucial. The most profitable saltmarsh lamb producers had secured access to expensive restaurants. In high-value markets such as these, tilapia can command twice the price – over £4 a kilogram – than in bulk markets. Peri-urban tilapia producers are well-placed to succeed because they have ready access to consistently strong urban markets, whereas rural sales, say to gastropubs, often fluctuate in line with tourism.

This has implications for policies to support innovation in the food chain. The *Eating Biodiversity* team argue that local and regional food initiatives should do more to support marketing, beyond publicising lists of food producers. Support to help producers gain detailed market information could play a valuable role. So could improved initiatives to help producers co-operate in ways that raise their bargaining power in the marketplace.

Policy proposal: refocus support for rural food chain innovation away from new product development towards ‘green’ conversion payments and market research.

Government

The RELU projects stress that regulators need to innovate alongside businesses so they become an asset to sustainable innovation in the food chain rather than an obstacle.

The projects find regulation can be a barrier but not, in these cases, because entrepreneurs simply drown in red tape. The *Biopesticides* project finds that a regulatory framework set up to handle chemical pesticides is ill-equipped to assess the safety and efficacy of biological control agents. The regulator’s efficacy models were inappropriate to biological pest control, their demands for experimental data were disproportionate, and they lacked access to relevant scientific expertise.

Yet the project also considers how the regulator – the Pesticide Safety Directorate (PSD) – is itself innovating to address these problems. The PSD has responded quickly, collaborating with the RELU team. The team says that the PSD’s corporate culture as part of the scientific civil service has been an asset, since it fosters an open and relatively flat management

structure: staff are free to discuss issues with outsiders and to have informal links with regulators in other countries. They also point out that people matter – specific personnel within the PSD have championed sustainable pest control within the agency.

Again, then, the projects suggest that if we want to promote sustainable food and farming, the challenge for government is not just to change farmers but also to change how it governs.

Policy proposal: introduce sustainability champions to regulatory agencies, responsible for scrutinising regulatory processes for barriers to sustainable innovation.

6 How to govern

The RELU projects help us refine policy objectives for sustainable farming and food. But what part should government play in turning those goals into reality? What is the role of government and where are its limits?

Food is such an intimate part of all our lives that you might expect even more than the usual soul-searching about our personal responsibilities and the role of the state. And so there has been. Should regulators restrict junk food advertising to children? Did government do enough to stop the spread of foot and mouth? Should it curb the power of supermarkets?

Yet, behind all this, is a growing confidence within policy about its own role and the hallmarks of good practice. This is built on the lessons learnt from BSE and from the 2001 foot and mouth disease outbreak, reinforced by successive in-depth surveys of public attitudes towards regulation around public health and climate change. It is embedded in codes of practice for decision-makers, guidance on better regulation, and new procedures for reporting and scrutiny.

Near the heart of this emerging consensus are three principles. Government should: make better choices easier for consumers, leading change in preference to imposing it; be based on strong evidence; and be 'joined-up', so government avoids undoing with one hand what it has achieved with the other. The food chain projects offer an interdisciplinary slant on these aims, questioning what choice, evidence and joining-up actually entail.

Choice

The success of policies to promote sustainable development and public health depends on them changing people's behaviour. The challenge policy makers are grappling with is how to do this without riding roughshod over citizens' freedom of choice.

The solution government has come up with, whether in *Choosing a better diet: the food and health action plan*¹⁵ or in policies to promote 'sustainable consumption and production'¹⁶, is to focus on interventions that will make it easier for individuals to make choices that are in the wider public interest. As Defra's *Forward Look*, puts it, people want government "to make it easier for consumers to take up sustainable habits and choices, rather than expecting them to go against the grain"¹⁷.

Yet 'choice' and 'behaviour change' are a paradoxical couple. The RELU projects give some insight into their relationship. In modelling the effects of policies and marketing to promote healthy eating, the *Farming Health* team consider how economic signals affect consumer food habits. They draw on behavioural psychology and economics to model people's willingness to constrain their own future actions, say by signing up for gym membership to start in the new year? Is that the kind of help people want from government to make healthy and sustainable choices – not just advising and cajoling us to have different preferences, but making some preferences more readily available than others?

Examples of such an approach – often called 'choice editing' – include the Food Standards Agency's work with food manufacturers to lower the salt content of processed foods. When it comes to greenhouse gas emissions, however, many food companies favour labels that present consumers with a choice rather than editing options for them. The idea is that a 'carbon label' commits a company to reducing its carbon footprint while also giving consumers the option to buy products with lower emissions.

The *Local Food* project casts doubt over carbon labels. While industry-wide standards would be needed for labels to work, standardisation is also part of the problem. Take an apple – the footprint of that same apple, from the same orchard, harvested at the same time, would change markedly through the year because of the energy used in storage. The footprint of seemingly identical vegetables could even vary from field to field on the same farm, depending on the soil type. In other words, argues the project team, standardised labels are next to meaningless.

Better, they say, to internalise the cost of emissions. This might be done through farmers trading carbon, a strategy the New Zealand government is considering. That way the carbon footprint of food could be reflected in the price, rather than being a separate 'choice' for consumers to consider.

Policy proposal: help the food chain take responsibility for environmental and health footprints by creating benchmarks for 'choice editing' and developing measures such as carbon trading that internalise costs to the environment.

¹⁵ Department of Health (2005) *Choosing a better diet: a food and health action plan*. DH, London. http://www.dh.gov.uk/prod_consum_dh/idcplg?ldcService=GET_FILE&dID=28556&Rendition=Web

¹⁶ HM Government (2005) *Securing the future: the UK government sustainable development strategy*. HMSO, London. http://www.sustainable-development.gov.uk/publications/pdf/strategy/SecFut_complete.pdf

¹⁷ Defra (2006) *Sustainable farming and food strategy: forward look*. Defra, London. <http://www.defra.gov.uk/FARM/policy/sustain/pdf/sffs-fwd-060718.pdf>

Evidence

As philosopher of science Arie Rip points out, government's commitment to 'evidence-based policy' hinges on another awkward pairing. After all, "policy is about the future, and evidence is about the past"¹⁸. So, evidence can never be enough to determine policy – the jump from the past to the future always leaves uncertainty about how far previous experience applies, and space for ethical decisions about what the future should be like.

The RELU projects improve the evidence base for policy and practice to promote sustainable food chains. The *Local Food* project, for example, uses Life Cycle Assessment to pinpoint changes in food production and consumption that will make a big difference to health or to the environment. The team finds that cooking in the home accounts for almost half the energy used over the 'life cycle' of a potato. Putting a lid over boiling water can make a big difference. In another instance, the team found that the nutritional quality of peas could be preserved if truck drivers pulled over tarpaulins to keep the sun off their half-full trailers during harvest.

Yet they also run headlong into this question of what counts as enough evidence. The *Local Food* team contend that current initiatives to put carbon labels on products are getting ahead of the evidence base. They risk putting in place footprinting standards that do not consider emissions all along the supply chain and therefore risk changing behaviour in the wrong directions. The project's message for the food industry is "Hang on!" – wait until the evidence base behind footprinting is stronger.

The *Food Risk* project encounters a contrasting scenario. In managing fast-moving crises, government and industry decision-makers often have to do something – to come to some kind of decision – on the basis of evidence that would not stand up to scientific scrutiny. Decisions are made on the balance of probabilities, sooner than science could fill any knowledge gaps. In crises, policy makers need to lead a precautionary approach rather than to wait until more evidence is in. Yet, even in general, the food system is so complex that uncertainty often persists in spite of further research. Policies that are frank about uncertainty are better placed to earn public trust.

Policy proposal: aim for 'precautionary policy' – based on evidence but explicitly alert to its limits.

Joining up

A third ambition of policy is to be joined-up¹⁹. The Strategy for Sustainable Farming and Food is good example of a joined-up approach, with objectives that cut across nutrition, social justice, animal welfare and the environment.

But it is much easier to talk about joining up than to put it into practice. If the aim is to have policies that get more public goods for their money, or that solve one problem without making a pig's ear of another, then perhaps part of the difficulty is that we think of it as 'joining up' as distinct problems or silos of knowledge.

The RELU programme takes a different tack. Instead of looking at separate problems and

¹⁸ Rip, A. (2001) In praise of speculation. *Organisation for Economic Co-operation and Development, proceedings, social sciences for knowledge and decision making*. OECD, Paris. Quoted in Stilgoe, J., Irwin, A. and Jones, K. (2006) *The received wisdom: opening up expert advice*. Demos, London

¹⁹ Cabinet Office (1999) *Professional policy making for the twenty-first century*. Cabinet Office, London. http://www.policyhub.gov.uk/better_policy_making/

then considering the overlaps, it takes an interdisciplinary approach. The projects frame the problems they research in unusually broad and systematic terms, combining social, economic and environmental concerns from the start.

For instance, the *Local Food* team include a health economist, a rural sociologist, a plant physiologist, a soil scientist and a specialist in Life Cycle Assessment. Their project asks whether 'local' food is any better than food from further away within the UK or overseas. Instead of looking just at the carbon footprint, say, at freshness or at the economic impacts, they look at all three angles and more.

Interdisciplinary research is well-equipped to find 'win-wins', where policies can achieve multiple objectives. For the *Eating Biodiversity* project, this is what RELU is about. They describe grazing on biodiverse pasture as a 'win-win-win': for the environment and ecosystems; for consumers, in terms of the health, taste and quality of meat like saltmarsh lamb; and for farmers, who gain a higher value product.

The *Tropical Fish* project also focuses on a potential win-win-win. Small-scale tilapia production can squeeze extra production out of existing resources and waste heat; tilapia is more nutritious than many foods people would eat instead and, because it is low down the food chain, does not suffer from high concentrations of mercury and other heavy metals; and, like saltmarsh lamb, it offers a way for farmers to increase their income.

Both research projects are about more than the mechanics of how to capture these win-wins. They also have implications for how we think about farming, food and policy. Even in ecologically sensitive areas, it can be better all round – for the ecosystem included – to allow grazing at a commercially viable stocking density. The *Eating Biodiversity* team want conservation and environmental stewardship policies to see that protective and productive land uses do not just need to be joined-up – sometimes they are the very same thing.

Policy proposal: encourage joined up policy by supporting interdisciplinary research.
