relu

Rural Economy and
Land Use Programme

Land to mouth

Exploring the links between sustainable land use and the food we eat

Food is fundamental to our existence and plays many important roles in our lives, both physically and culturally. We take it as a given that there is such a thing as a healthy diet. Can the way we use land to produce food promote such a diet and make us healthier? And what about the rural land on which food is produced, and which we generally value as a national asset? Can we as consumers, alongside food producers, promote the health of the rural environment?

These are issues that the Relu food chain research addresses and here we draw out some implications from across the suite of projects.

Land to mouth

Exploring the links between sustainable land use and the food we eat

The projects

Eating biodiversity

Realising the Links Between Quality Food Production and Biodiversity Protection

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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.

Farming for health

Implications of a Nutrition Driven Food Policy for the Countryside

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

Reforms to Europe's Common Agricultural Policy are progressively exposing farming to market forces. Meanwhile, in the marketplace, health and diet are growing concerns for policy makers, food companies and consumers. How might dietary change affect the rural economy and landscape? Will we rely on imports 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 also provide health benefits? How much are consumers prepared to pay for healthier food?

The Farming for 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.

Tropical fish

Warm water Fish Production as a Diversification Strategy for Arable Farmers

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

Most people in the UK eat less fish than nutritionists advise. But how can more sustainable supplies be achieved when wild fish stocks are in decline? Almost half the fish eaten world-wide are now farmed, but fish farming can wreak a heavy toll on the environment through overfishing for wild species to feed the captive fish and through pollution. 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 warm water 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

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

'Food miles' has become 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 and help fight global poverty than to get it from down the road?

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 different parts of the UK, Spain, Uganda and Kenya. 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 environmental impacts and cultural values.

Biopesticides

The Role of Regulation in Developing Biological Alternatives to Pesticides

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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 fulfilling 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 explores 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

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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. Microbial pollution from livestock manure and faeces deposited by grazing animals 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 asks how farmers can manage manure and livestock in ways that reduce the risk of microbial pollution by considering both physical and social risk factors. They study how long faecal indicator organisms survive in the environment and how they end up in water, and map the risks of microbial pollution at different times of year on livestock farms. They also consider the human dimension: who should be responsible for managing this risk, what are the barriers to taking action and what sanctions would encourage changes in management practices?

Food risk

Managing Food Chain Risks

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We expect our food to be safe and when problems arise they can have a devastating impact, not only on the health of individuals, but also on food producers and exporters, and on the economy. In a world where the food chain is increasingly complex, who should be taking responsibility for food safety? Should we be leaving these things to the experts?

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 rural communities – can help risk managers take wider consequences into account. These 'outsiders' can bring new knowledge to the attention of risk managers and test assumptions. However, experts and non-experts don't always talk the same language. The project is developing ways for risk managers and stakeholders to communicate with each other about food safety.

The projects

Can the way we use land make our food healthier and safer?

We expect a wide range of benefits from our food in the UK. We want it to keep us healthy, safeguard a countryside that we can enjoy and provide a secure living for people who live there. But are these aims always compatible?

Early results from the Farming for Health project's modelling work indicate that a reduction in demand for dairy products would cause a significant decline in the number of dairy herds across the country, but particularly in the south east and West Midlands, these being replaced by grass-fed beef or sheep on fertile lowland pastures. Reduced demand for meat, plus increased competition from the lowlands, would make upland livestock production less economic, leading to either ranching, or even land abandonment in some cases. Fruit and vegetable growing, particularly of soft fruits, would increase significantly, particularly in the traditional growing areas of the south and east but also, to a lesser extent, other areas, often through the use of polytunnels. Overall, such a change to a healthier diet could hit many livestock producers hard, particularly in the more marginal areas of the uplands and the south west, leading to loss of employment, as well as significant changes in the character of hill and upland landscapes.

We are also encouraged to eat more fish for health reasons, but stocks of wild fish are declining and fish farming has acquired a bad name because it has been associated with pollution and poor welfare standards. Even health conscious consumers may hesitate to opt for either wild or farmed fish for these reasons.

We know that changing something as fundamental as the nation's eating habits is very difficult. Although the national Five a Day Campaign has been quite successful in raising awareness of the health benefits of eating more fruit and vegetables, changing what we actually do in our daily lives has proved much more difficult.

Eating for health

Eating well is a major factor in keeping healthy. One of the major concerns for the Government today is obesity and we know that if trends continue, by 2010 about one third of all the men, women and children in the UK will be obese. Being overweight and eating a poor diet have been associated with a range of common maladies, including heart disease, strokes, diabetes and some cancers. At the moment we eat too much saturated fat and too little fruit and vegetables and we don't take enough exercise. If we increased our consumption of fruit and vegetables by 50%, in line with World Health Organisation and Department of Health guidelines, and reduced our intake of saturated fat by 75%, what effect would that have on land use and the countryside?

Ultimately, the success of policies to promote sustainable development and public health depends on changing people's behaviour. The challenge policy makers grapple with is how to do this without compromising citizens' freedom of choice. 'Choice' and 'behaviour change' are indeed a paradoxical couple and the Relu projects give some insight into their relationship. In modelling the effects of policies and marketing to promote healthy eating, the Farming for Health team considers 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, for example by signing up for gym membership to start in the New Year. Do people want the Government to help them eat more healthily by limiting their choices? Should the healthier options be more readily available than the unhealthy ones, or should the Government confine itself to advising and cajoling us to make the "right" choices?

Or there is another approach. If you can't change the range of foods that people eat, can you change the nutritional qualities of the foods that they do eat? Both the Farming for Health and Eating Biodiversity teams have come up with results showing that animals grazed on biodiverse pastures produce meat with a healthier fatty-acid profile. The Eating Biodiversity team compared beef, lamb and cheese produced on species-rich moorland, heaths and saltmarshes with products from ryegrass pasture and also found higher levels of vitamin E produced on the biodiverse pastures. Farming for Health compared lettuce and strawberries grown under UV transparent and traditional plastic and found that the former contained more nutrients, although there was some reduction in yield. These new, more nutritious products would be more expensive. But results from the research indicated that consumers would be prepared to pay a premium for them.

Is there potential for other novel healthy products, such as unfamiliar types of fish? Fish is a healthy food and we are urged to eat more of it, but how can we achieve that while also protecting the environment? The Tropical Fish project has found ways in which mainstream farmers, growing tilapia indoors, could exploit a growing market for fresh fish.

People say they want healthier food and they are prepared to pay for it, but does that imply that they want their food to be local? Freshness is important to shoppers, according to the results from the Local Food project, and according to their analysis, local food bought and eaten in season may be more nutritious. Out of season this may not be true, since nutrient loss is higher during long-term storage than long-distance transit. On the other hand, the team acknowledges that any kind of fruit and vegetables – stored or fresh – is better than none.

The wider implications

- Continuing to promote a seasonal five portions of fruit and veg a day, could be beneficial for health, local economies and the environment and it is happening via initiatives such as the "Health Challenge for Wales" programme. Another avenue to consider would be to link VAT policy directly with healthy eating through zero-rating products such as fruit juices and smoothies and taxing "unhealthy" foods such as saturated fats.
- Eating fruit and vegetables at their freshest is good for us, and in season this can mean eating local produce, which may be good for the environment too. Regional health and development agencies and the food sector could work together more to promote this approach.
- More support for novel farm diversification that also promotes health, such as producing tilapia indoors, could be beneficial and encourage people to eat more healthily.
- The variety of produce grown and the way food is produced can influence its nutritional quality. Given that people are slow to change their eating behaviour, improving the nutritional quality of the food that is grown may be as important as changing diets. Results from the Farming for Health and Biodiversity projects suggest that improving production systems could have a significant effect on the healthy qualities of some foods. The potential market advantage of these healthier foods, and appropriate quality assurance schemes that emphasise nutritional quality, could encourage producers to adopt such systems.

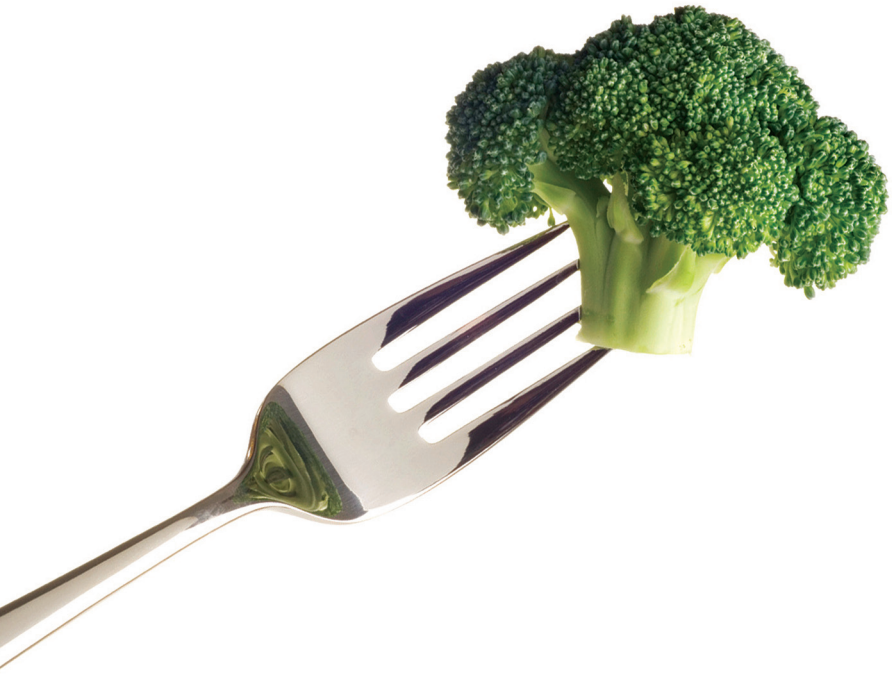
Maggie Gill, Rural Affairs and Environment, Scottish Government:
"What I welcome in the [Relu] programme is the increased emphasis on reconnecting the consumer with different parts of the food chain and I hope that leads to a renewed interest in and awareness of the benefits of eating quality food."

Caroline Drummond, Linking Environment and Farming (LEAF):
"One of the key areas that interest us, within LEAF, is the communication and involvement of consumers in food and farming and understanding more about how you change consumer behaviour. I think the farming industry has gone a long way to deliver more sustainable farming practices. It's making sustainable consumption happen that is fascinating and, I think, a very big challenge."

Frances Rowe, One NorthEast:
"If nutritionally superior food produced through more environmentally beneficial systems is better for you but it is harder to get – it's not available in the supermarkets necessarily and it costs more – what does that mean for people who are on lower incomes? Where's the fairness in that? Maybe the question is about getting healthier food available to everybody."

Eating safely

We expect our food supplies, above all, to be safe, but in reality there are risks all along the food chain. Who should take ultimate responsibility?



People in the UK suffer an estimated 860,000 cases of food poisoning a year, with a financial cost of £1.5 billion. Contaminated water is just one source of this kind of poisoning and the Livestock Waste project focuses on how changing land use practices can help contain the risk of faecal pathogens endangering bathers and people eating shellfish and irrigated vegetables such as lettuce. The project has found that, if properly informed about the relative risks of various husbandry practices, farmers can manage manure and livestock in ways that reduce the risk of contaminating water supplies. Significant 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 tailor general rules about risk to the situation of real farms. The policy challenge is to make it worth farmers' while to help reduce a diffuse risk.

Eliminating risk at source may not always be feasible and those down the food chain need to take proper precautions. The Food Risk team has looked at one very common cause of food poisoning, campylobacter, where the potential for risk management is distributed more evenly along the supply chain. While risks of contamination with this organism can be reduced in production and processing they cannot be eliminated completely, so consumers need to be alert and follow food safety advice in order to reduce cases of poisoning.

Dave Chadwick, Institute of Grassland and Environmental Research (IGER), Relu Livestock Waste project:

"There are some very simple and low cost mechanisms to try to reduce the risk further in terms of pathogenic transfer to water courses from manure and livestock management. It's good agricultural practice, for example, to prevent run-off from fields, not to apply slurry at times when there is rainfall predicted, or when you have very wet conditions."

Gerald Manning, Farmer:

"During my farming career, the great debate about security of food supply has raged, but since the years of plenty the debate has increasingly turned to food quality, health issues and the environmental impacts of agriculture – and rightly so – as this debate has raised many unanswered questions, not the least of which is where the buck stops for mitigation and regulation. One thing is for sure, whatever the level of regulation, the risk from eating food and enjoying the great natural world will never be totally eliminated."

Responsibility for managing the various risks involved in food production has to be clear and consumers need to know exactly what has gone into their food and where it comes from. Transparency is vital if food is to be made as safe as possible.

But when the Food Risk team asked stakeholders to map the food system, they were struck not just by how complex supply-chains are, but how untraceable they can become at certain points along the journey. Ingredients for even simple processed foods are bought in bulk on world commodity markets and manufacturers may use palm oil one week then seed oils the next, depending on prices. This can make the food system vulnerable. In 2005, the illegal use of Sudan-1 as a colourant in one brand of Worcester 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.

This implies that sometimes the experts get things wrong. Sometimes it's also difficult to see exactly who did get it wrong or who should take responsibility. Would it help if more stakeholders and members of the public were involved in making key decisions? The Food Risk project explored whether wider participation can be helpful during risk and crisis management or, if time is of the essence, is it more important just to get on with making decisions? Their workshops with both risk "experts" and "non experts" have shown how risk and crisis management can be strengthened by involving a diverse range of stakeholders such as campaigners, farmers, rural businesses and social scientists. Enabling people with relevant non-technical knowledge to contribute can help risk managers to consider the practical implications of different risk management options. It can also help decision-makers to see problems in a new light. This is endorsed by the Livestock Waste project who have run a citizens' jury to explore how microbial contamination risks from manure should be handled.

Getting people involved means making technical concepts easily accessible. The Food Risk team has developed a way of doing this, using an IT programme that works like "fuzzy felt" that consumers can use to map their understanding of the food chain.

The wider implications

- Many factors besides land use contribute to food contamination, but policies affecting land use can offer one important means of intervening. The Government, for example, is already running the Catchment Sensitive Farming Demonstration project, identifying and recording on-farm diffuse pollution risk and testing various incentives for the uptake of measures to tackle this.
- Farm support and extension services could be used further to encourage responsible manure management that would make water safer.
- Overcomplicated supply chains involving many different suppliers tend to increase risk and uncertainty because of the difficulties in knowing the provenance of all the ingredients involved and in allocating responsibility. Liabilities and comebacks seem unclear in many aspects of the food chain. We need more transparency about the source and risks of food ingredients.
- A wide range of "non experts" can be involved in risk assessment and management, as long as we use appropriate means and language. The Food Risk team has also shown that consumers can play a useful role in making food production safer, for example by appropriate food handling and cooking in the home.

Monica Truninger, Bangor University, Relu Local Food project:

"It seems that consumers are portrayed as a bit dumb. It is not acknowledged that consumers can express themselves, they can talk about the food chain in quite sophisticated ways. They are not stupid."

Gary Barker, Institute of Food Research, Relu Food Risk project:

"One of the things that come out most from the actual interactions we have had with real people in real events, is that they feel they don't get enough information. Anything that improves information and confidence in information is really helpful."

Diversity

Diversity, whether in farming, rural development, food or human populations, is generally seen as a strength. Healthy eating advice points us towards "a good, varied diet". We value ecological diversity in the environment. Can these different kinds of diversity actually reinforce one another?

Farmers are always being told to diversify to remain solvent during a period of falling farm-gate prices and farm subsidy reform, and this is often taken to mean that they need to make money on activities outside agriculture, such as running bed and breakfast accommodation for tourists. However, diversification can also mean moving into different areas of agriculture. Biofuels, for example, offer new opportunities for farmers, but there are also potential new food crops and new approaches to traditional products. Two of the Relu projects focus on using farm resources in new ways that produce high value food for new markets.

The most radical of these is the Tropical Fish project, which explores whether it is viable for farmers to grow tilapia on a small scale alongside more mainstream agricultural activities. Researchers have found that this could be a realistic and ecologically friendly way of supplementing farm incomes, making use of waste heat and spare buildings. Although mainstream fish farming has acquired a bad name because of pollution and the escape of farmed fish into the wild population, farming tilapia could be a much "greener" option as it takes place within an enclosed system. The waste products are filtered out and can be used as fertiliser and the fish itself feeds low down in the food chain. Escapes from such a system are unlikely but if they did occur this tropical fish would be unable to survive so it poses less of an ecological risk. In welfare terms, it is also a good choice for this kind of farming, as tilapia do not migrate in the wild and seem to prefer to live in dense groups. Eating tilapia could be an environmentally sound choice that is also good for human health.

The Eating Biodiversity study may look more conventional, encouraging farmers to boost their earnings with high-value niche products such as saltmarsh lamb. However, it is actually about enabling conservation and farming to work together in a symbiotic relationship, rather than seeing the two outcomes as mutually exclusive. It shows how the biodiverse pasture and the meat it produces are each necessary to the other, and how farmers and the landscape can benefit from this relationship. This actually runs contrary to the traditional view of conservation, where areas are "protected" from farming activities.

The Eating Biodiversity team has looked at different aspects of the beef, lamb and cheese produced on specific biodiverse pastures. They have shown that the meat is in certain respects "healthier", with more beneficial fatty acids than conventional products. The taste panels they have set up like the flavours. They also like the variation, from season to season and year to year, which enhances its image and seem willing to pay a premium for these "natural" qualities.

The wider implications

- The level of grazing on sensitive ecosystems is often key to their survival and there may be problems with over or undergrazing in different areas. The timing and mix of stock may also be important.
- There could be more support for producers in marketing UK "terroir" products such as salt marsh lamb, that emphasises the natural variation and seasonality of these, and more research on consumer willingness to pay a premium for such foods.
- Support for marketing locally grown "green" products such as tilapia could be good for health and for the environment.
- As food and fuel prices rise in line with global demand, the financial support from environmental stewardship schemes may become less important to farmers. In that case, finding ways in which biodiversity can actually enhance farmers' profits may be vital to maintaining the ecological balance.

Can consumers help the environment?

If how we grow our food and use our land can help us to be healthier, can the choices that we make as consumers help the environment to be healthier? If they can, should we make those choices freely, or should the Government be steering us towards the "right" choices, either by persuasion or coercion?

Local food

Our buying habits could support biodiversity and enhance our environment, but what about climate change, which could influence all of our decisions in the future? Food miles have become yet another consideration for the discriminating consumer to take into account when making choices.

The Local Food project has examined this issue in a much more holistic way than has hitherto been the case. Rather than concentrating only on food miles, they have looked at the whole lifecycle of some key products and found that the picture is far from simple. Production methods can be a major factor in how much carbon is released, but so can the type of soil in which crops are grown. Initial work suggests that UK soils are a major source of carbon emissions – producing up to a third as much carbon as industrial emissions – but this can be reduced through changes in land management.

Another surprising finding is that buying "local" food all year round can actually be a poor environmental choice. Storing food uses energy, and stored food may prove to be less carbon-efficient than importing it out of season. While eating lettuce grown in England is better for the environment in the summer, growing them under glass throughout the winter may do more damage than importing them from Spain.

In the light of these findings, 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. If some apples are stored before being eaten, then the footprint of apples harvested from the same orchard and eaten at different times during the year would differ markedly because of the energy used in storage. Would any carbon label be able to reflect this? 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 and it would be better 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.

Here we have a dilemma. Winter lettuce from Spain may be less harmful than those grown under glass in this country, but how should we balance the environmental impact against the public health benefit? Should we be eating tomatoes at all during the winter?

The wider implications

- We need five portions of fruit and vegetables a day in order to sustain our health but perhaps we need to be encouraged to make those UK products in season. Local may not always be best for the environment, or even in terms of freshness, but in season, it probably wins.
- Health authorities and local development agencies could work with retailers to highlight the benefits of a seasonal approach to food and of variety over the year.
- More information about environmentally beneficial production systems needs to be available and consumers need to be more aware of the links between production systems, their health and the environment.
- Carbon labelling that doesn't take into account the actual lifecycle of individual products will not achieve the desired result. Actually measuring performance, rather than averaging it out, could provide the basis for rewarding and motivating improvement but would be very complex.

Gareth Edwards-Jones, Bangor University, Relu Local Food project:

"What we are trying to do is get the evidence base that will challenge people's dogma. That's quite difficult because food is so important to people for so many different reasons. It's quite difficult for them to accept the science because it will mean they might have to give up some of their cherished beliefs and that's a challenge for science, trying to persuade the green movement and other campaigning bodies to be more open minded about some of the science."

Innovation

We need innovation to ensure thriving rural businesses and sustainable food production and all the Relu projects touch upon this. Can entrepreneurs play a part?

The Tropical Fish, Eating Biodiversity and Farming for 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 Local Food and Livestock Waste projects look at how to drive innovation and change on farms and within the supply chain to the benefit of the public and the environment. The Biopesticides project addresses regulatory barriers to innovation in pest control and, like the Food Risk work on risk management, also considers how regulatory bodies themselves can innovate.

The projects challenge how we think about innovation and policy efforts to promote it. Who innovates and why, and what are the main barriers they face?

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. 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. But, while many of the entrepreneurs they interviewed are passionate about ecological farming, most started farming this way because it made good business sense. Many indeed, were first generation farmers, often with non-farming business experience.

The Tropical Fish project finds that some businesses moving into small-scale tilapia production are not rural at all, but make use of spare buildings in peri-urban areas. People already involved in tilapia production in the UK, or thinking of moving into it, cite many different reasons for doing so. Some are serial entrepreneurs, others 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 circumstances 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 and existing commitments of would-be entrepreneurs.

Is a healthy and environmentally friendly diet compatible with innovation and sustainable business?

Ian Brown, farmer and One NorthEast Board Member:

"People are looking for fresh, natural, local produce... but my worry as a farmer who has made that long journey from the farmhouse to serving canapés is that most farmers do not understand what the general public are looking for, and conversely most of the population of this country do not understand the real issues in terms of growing food."

Barriers

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.

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. Another barrier is that the systems that supermarkets and other big players use to manage their supply chains may 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 gradually to adopt biological control measures that might meet environmental and health goals, while also helping to limit plant disease.

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. The Netherlands, for instance has taken a different approach, based on government support and implementation through a public-private partnership known as the Genoeg scheme.

The Local Food team has 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.

As for the success stories, the Eating Biodiversity and Tropical Fish projects both find that access to the right markets is 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.

This has implications for policies to support innovation in the food chain. The Eating Biodiversity team argues that local and regional food initiatives should do more to support marketing. 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.

The wider implications

- The balance of costs and benefits, or uncertainty about them, is often not favourable enough for potential entrepreneurs entering novel markets. They may need some support in establishing markets.
- Local and regional food initiatives could help producers to gain detailed market information. Support to help them in placing their products, accessing the right markets and understanding the expectations of customers would help to overcome some of the uncertainties that potential entrepreneurs face.
- Private sector governance systems can hold back innovation that could be in the public interest. Retailers actions are often driven, quite legitimately, by a desire to gain an edge over competitors rather than a desire to promote alternative products, such as biopesticides.
- Supermarkets and other retailers have a role to play in encouraging and assisting small producers to differentiate and gain market advantage for greener/ healthier products

Henry Buller, Exeter University, Relu Eating Biodiversity project:
"Our idea is that value within the food chain can be derived from many different sources. It's not simply value in terms of producing the most for the least cost; there are additional values that we seek to bring on board, such as a good landscape, the value of protecting biodiversity on grazing land, the value in the quality of the meat that can be derived from such farming systems."

Wyn Grant, Warwick University, Relu Biopesticides project:
"Essentially a biopesticide is a much safer pesticide than a chemical pesticide because you are using things that are present naturally in the soil anyway. What you are doing is increasing their presence. They don't have toxic residue so they don't present the kinds of problems that chemical pesticides do. But of course just because something is natural doesn't mean it's safe, so there still has to be a proper scrutiny. But the whole system of regulation has been set up to regulate chemical pesticides and not this new generation of products."

Frances Rowe, One NorthEast:
"I'd like to know more about whether or not local food can be good for regenerating places as well as good for local economies – that's an outstanding question for me."

Evidence into policy

The Relu projects help us refine policy objectives for sustainable farming and food. But what part should the 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 the 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 several 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 it avoids undoing with one hand what it has achieved with the other. The food chain projects offer an interdisciplinary slant on these aims.

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 whether circumstances may change in unexpected ways – but it is essential. The Relu projects do improve the evidence base for policy and practice to promote sustainable food chains. The Local Food project, for example, uses Lifecycle 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 'lifecycle' 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.

They also raise the question of what counts as enough evidence. The Local Food team contends that current initiatives to put carbon labels on products are getting ahead of the evidence base. They risk putting in place foot printing 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: wait until the evidence base behind foot printing 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 but participatory approach, rather than wait until more evidence is available.

The wider implications

— 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. We need to aim for "precautionary policy" – based on evidence but explicitly alert to its limits.

What is the role of the Government?

Joined-up policy

We hear frequently that the aim of policy is to be joined-up.

The Strategy for Sustainable Farming and Food is a 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 creating worse difficulties elsewhere, then perhaps we have to step back a little. Too often we just attempt to join up distinct problems, or silos of knowledge. The Relu programme takes a different tack. Instead of looking at separate problems and then considering the overlaps, it takes an interdisciplinary and a much more holistic approach. The projects frame the problems they research in unusually broad and systematic terms, combining social, economic, biological and environmental concerns from the start.

For instance, the Local Food team includes a health economist, a rural sociologist, a plant physiologist, a soil scientist and a specialist in Lifecycle 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 investigate all three aspects 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 might otherwise be eating and, because it is low down the food chain, does not contain high concentrations of mercury and other heavy metals. Also, 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 wants 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.

Deirdre Hutton, Food Standards Agency:
"How do we give consumers the information in a way that helps them to make the "right choices" for themselves – particularly when deciding what is right can be so complex? I'm a firm believer in harnessing consumer demand. Markets move much more efficiently in response to their consumers than they do to the diktats of the regulator."

The UK research councils' Rural Economy and Land Use Programme was launched in 2003 to carry out interdisciplinary research on the multiple challenges facing rural areas. The programme is an unprecedented collaboration between the Economic and Social Research Council (ESRC), the Biotechnology and Biological Sciences Research Council (BBSRC) and the Natural Environment Research Council (NERC). It has a budget of £24 million, with additional funding provided by the Scottish Government and the Department for Environment, Food and Rural Affairs (Defra).

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