

**OXFORD FARMING CONFERENCE/ROYAL
NORFOLK AGRICULTURAL ASSOCIATION
AWARD**



**The politics of climate change and its
impact on arable farming**

Completed September 2007 By Ed Buscall

The views expressed in this report are entirely my own and do not necessarily represent the views of the Nuffield Farming Scholarships Trust, or my sponsor, or of my employers, or any other sponsoring body.

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A farmer goes to Notting Hill

“Excuse me, but would you know the carbon count of these vegetables? I’m trying to go carbon neutral.” A snippet of a conversation overheard at an organic supermarket in rarefied world, but see how thousands descend on this most fashionable of districts every weekend, and you know it’s the place to go if you’re looking to identify future trends of the urban shopper.

And so it has proved. In the two years since, the green revolution has gathered a striking – some would unstoppable – momentum, even though the debate over global warming remains contentious.

The predictions of scientists working for the Intergovernmental Panel on Climate Change are well known and well publicised. The latest in April 2007 (see below) suggested widespread droughts, mass migration and the extinction of hundreds of species by 2050 as a result of the planet warming by around four degrees Celsius. The cause of this temperature increase, it stated, was “very likely” to be due to man-made greenhouse gas emissions.

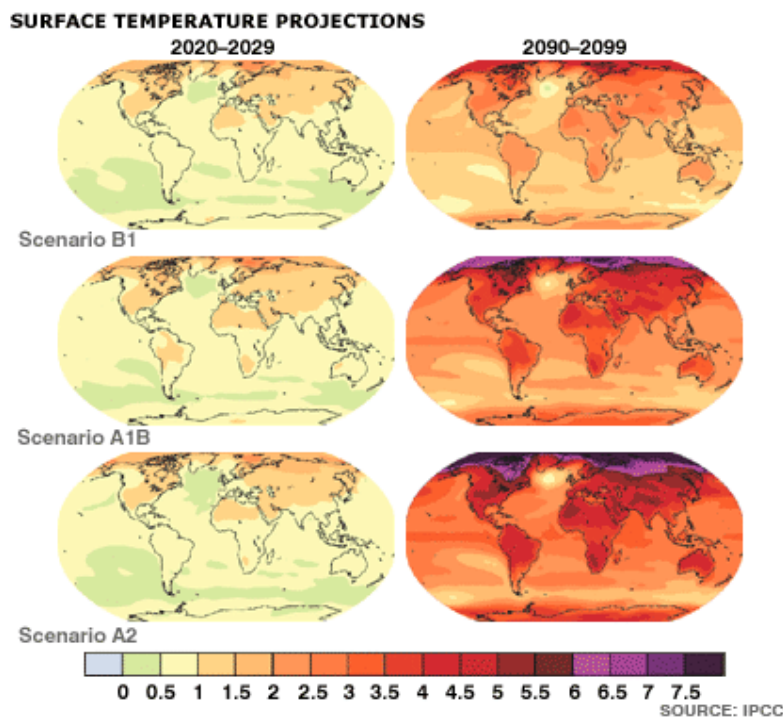


Diagram 1: The Intergovernmental Panel on Climate Change predicts that temperatures are most likely to rise by 1.8C-4C by 2100. But the possible range is much greater; 1.1C-6.4C. The maps above show how a range of three different scenarios will affect different parts of the planet. The emissions scenarios, A1B, A2, B1, used to create the maps above, are based on a range of detailed economic and technological data. These versions of the future consider different population increases, fossil and alternative fuel use, and consequent carbon dioxide increases.

The trouble is the science behind these doom-laden scenarios is all based on modelling and theory, so a counter argument can always be found. If you want to argue that global warming is, say, caused by the sun's increased solar activity cutting down on cloud formation, you can find a whole set of different scientific models to back up that particular theory. After all, nobody knows the future.

The greening of British politics

However for politicians in the UK, there appears to be no doubt that man is the cause of global warming. Every utterance from the IPCC is met with much hand-wringing from Westminster and calls for society to alter its ways.

Indeed, the political bandwagon on climate change seems to be moving ahead of the scientific debate in the UK. The decision to embrace all things green by the opposition Conservative party under its bike-riding, wind-turbine-owning leader David Cameron has created a profound change in the political climate. In the corridors of power, to be seen to be green is to be seen to be modern and in touch with the prevailing popular mood.



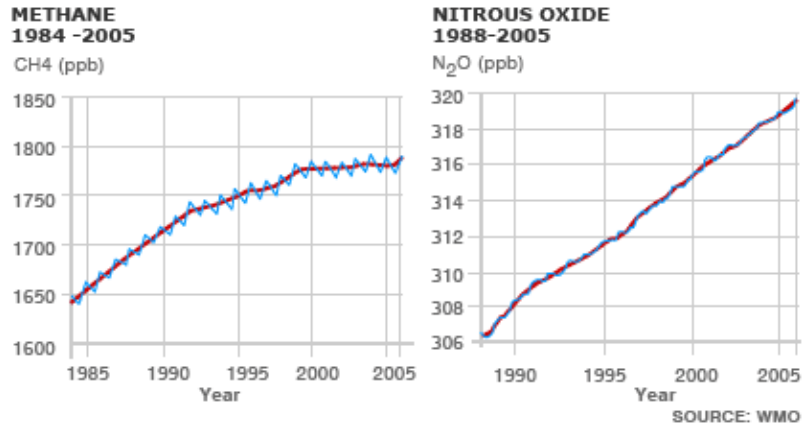
Dave Cameron – Leader of the Pack?

Not wanting to miss a trick, the government has been quick to react to the challenge. In March, it published a draft Climate Change Bill, the first of its kind in any country. This set out a framework for moving the UK to a low-carbon economy by making ambitious targets for reducing carbon dioxide emissions legally binding – 60 per cent by 2050 and 26-32 per cent by 2020. Indeed, the environment looks set to rival the traditional big issues of education, health and the economy in importance at the next general election.

And no wonder. The rise in demand for organic food, the space in magazines given over to green living and the emergence of new phrases like carbon footprint tells you the extent of the public shift on environmental matters. Meanwhile, reputable organisations like The Carbon Trust point to what they call “a tipping point” between now and 2010 in public perceptions over climate change. They believe that as an issue its visibility will only grow as severe weather and increasing political and media debate affect the public consciousness.

But has the farming community understood the consequences of this profound change in political thinking, particularly about what it might mean their business? Certainly, the industry has been keen to jump on the green bandwagon, promoting the role agriculture can play in the production of biofuels. And who can blame it? After all, the price of oilseed rape has gone up by at least 30 per cent in the last 18 months to two years.

However, the industry had made little attempt - with the noted exception of the CLA - to consider ways of reducing agriculture's own emissions. Farming produces 7 per cent of this country's greenhouse gases, mainly because of its nitrous oxide and methane emissions.



Global methane and nitrous oxide rises. Both have a much smaller presence in the atmosphere than carbon dioxide but are much stronger greenhouse gases; methane has over 20 times the effect of carbon dioxide, while nitrous oxide is nearly 300 times stronger.

This is despite the Labour government pointing to the need for the industry to consider its environmental footprint, dropping in the catchphrase “one planet farming” whenever and wherever it can. Rightly or wrongly, the government has also made it quite clear that it believes that farming in the future will be defined not by providing food security, but by the environmental good it does.

The response by farming groups has been – even giving them the benefit of the doubt – been superficial. A year long scheme – subsidised by DEFRA to the tune of just £170,000 – has been established by the NFU, CLA and others to communicate to farmers all things to do with climate change. It's better than nothing, but it's not much when tackling an issue so large and potentially so important to an industry so diverse.

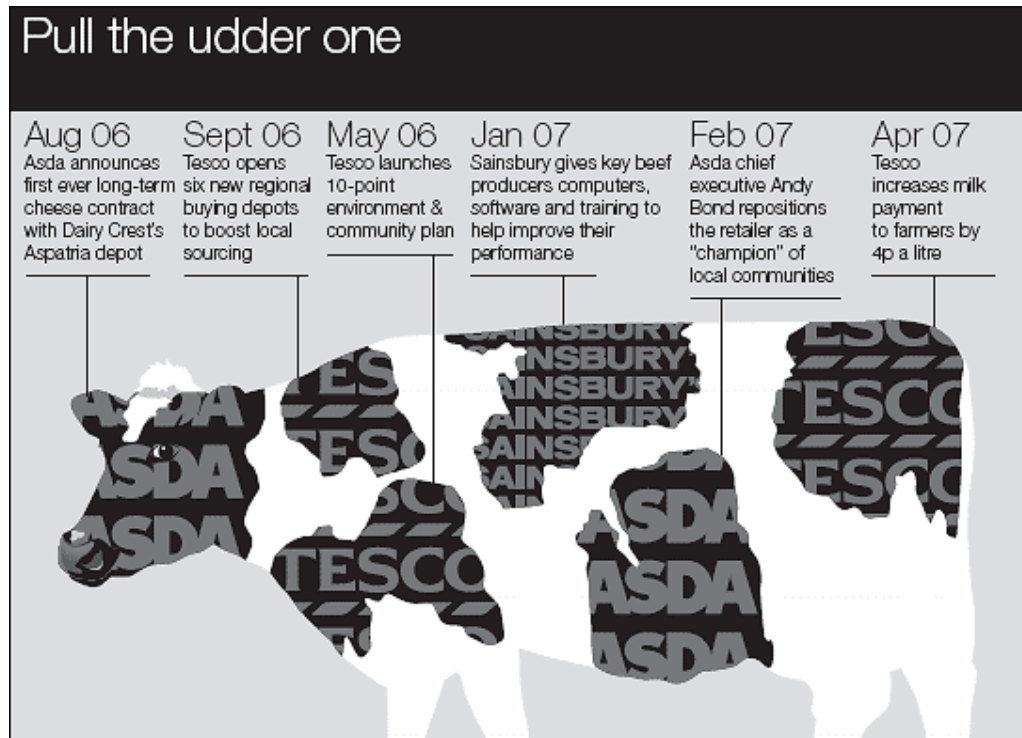
Bet my supermarket's greener than yours

Beyond the farm gate, meanwhile, Britain's leading companies are falling over themselves to announce their latest green initiative and their intent to become carbon neutral. While not doubting their commitment to the environment, some might argue that this green conversion has more to do with the desire to regulate themselves, rather than by government, and the need to preserve and bolster the company's image to the wider world.

Chief among these companies – surprise, surprise – are the big supermarkets. With their antennae always close to the ground, the chief executives of Tesco, Marks & Spencer and the

likes have announced some of the most radical plans for reducing their carbon footprint. They say their customers want greater choice in purchasing sustainable food and that it makes good business sense for their shops to lead what they describe as “a green revolution in consumption”.

Others are less charitable, pointing out that this rash of initiatives might have more to do with trying to mollify the Competition Commission as it continues its inquiry into the Big Four supermarkets. Indeed in the first eleven months after the inquiry was announced, Tesco, J Sainsbury, Asda and WM Morrison have launched more than 50 separate supplier and environmental initiatives.



Sunday Telegraph

Whatever the incentive, the supermarkets' plans hold serious potential consequences for their suppliers, including farmers. An example of what could well be coming our way was given to me by a tomato grower I met in north California near the state capital Sacramento while on my Nuffield travels.

He had just received something called a Sustainable Audit from Sysco, one of the biggest suppliers of restaurants in the United States. Sysco had told his tomato canning factory, which was a cooperative, that if they wanted to remain a supplier all their members would have to abide by it. The audit asked a range of detailed questions about soil, nutrient and pesticide practices. The bottom line, according to the grower, was that he was facing an extra layer of regulation and expense to help Sysco green up its image. Yet he felt he had no option but to comply.

Indeed, tomato growers across California are now working on their own industry guidelines on environmental sustainability. Farmers will be able to opt for one of four different levels and their scores would then be passed on to customers. Why had they decided to spend time devising a whole new layer of administration for themselves? Because they can see the

writing on the wall with other major customers, like the supermarket chain Walmart, deciding to adopt a green agenda. If they provide their own self-regulated scheme, then they will not have to answer the sustainable audits of each and every company they are asked to supply.

If you're wondering what relevance this might have to the British farmer, think what might happen when Tesco fulfils the most headline grabbing scheme in what it calls its Community Plan. This is a promise to put new carbon labels on every one of the 70,000 products it sells so that shoppers can compare the carbon emissions associated with its production and processing in the same way they can compare salt content and calorie counts.

Quite how they will find an accurate measuring system for this is difficult to see. However, food manufacturers and retailers do clearly believe it is important for their brand to demonstrate to their customers that they are concerned about the environmental footprint of their products. Below is a recent press release sent out by Walkers Crisps:



Chapter 2 Walkers carbon footprint

Calculating the carbon footprint of a packet of Walkers Cheese & Onion Crisps

The final carbon footprint calculation is 75g.

The flow-chart on this page shows exactly what percentage of our carbon footprint is expended at each stage:

- **1: Our raw materials: Potatoes, sunflowers and seasoning**
- **2: Manufacture: Producing crisps from potatoes**
- **3: Packaging our crisps**
- **4: Distribution: Bringing our crisps to you**
- **5: Disposal of the empty packs**

Of course, this calculation is only based on current operations and available data. As new information comes to light and we continue to improve our environmental performance, we aim to continually reduce our emissions.

Working out such figures clearly costs money. In its endeavours to go green, the high street chemist Boots has recently added carbon footprint labels to two of their makes of shampoo. The labels told the customer how much carbon dioxide had been emitted during each bottle's production and transportation to the shop. This initiative, according to the company, has cost it £250,000.

If that is the cost for preparing two labels, then the bill for Tesco to fulfil its promise of carbon labelling all its 70,000 products would come to around £8.75bn. That's just under four times their profits for last year. On top of that, they may need to chuck a few more million into several campaigns to teach the public what the labels actually mean.

And what are the chances of Tesco picking up the entire bill for this scheme? A smart company with lots of shareholders to please, it has a well proven track record for passing on costs and the burden of regulation to its suppliers, as farmers know only too well.

The need to think green

So it would appear the farming industry is in danger of facing a pincer movement in terms of new regulation from both the political and commercial spectrum unless it takes the initiative on this increasingly important issue.

That's why I used my Nuffield scholarship to look at ways agriculture could be more proactive and innovative in finding solutions for mitigating climate change within the industry. I also believe that a long hard look over the way we deal with greenhouse gases offers us a chance to build on efforts to show our relevance in modern society by promoting ourselves as both "custodians of the countryside" and as producers of sustainable local food.

My first stop was Australia. Why? Mainly because the country was facing a severe and prolonged drought that was creating a sea change in Australians' thinking on climate change. And with an election later this year, politicians were rushing to react. A previously sceptical government was now pushing a wide range of climate change plans from diverting the country's main rivers to introducing a national carbon trading scheme.

The long drought there has shown farmers the harsh realities of living on the frontline of climate change. Driving through New South Wales and Victoria last February, I was met with parched barren landscapes, dust clouds and dried out riverbeds. From every doorstep came tales of the social damage the climate had wrought on rural neighbourhoods with increased suicide and divorce rates.



New South Wales farmland stricken by drought

Whether this extreme dry period was man-made or not, it has also changed perceptions about the country's vulnerability to climate change for those living in the city – a critical development in the political debate. Not happy about facing water shortages and concerned about future supplies, urban Australia has forced its politicians to grasp the environmental nettle.

With the political debate significantly altered and moving rapidly, farming unions have been forced to stake out their position on the issue in a more determined fashion. The country's main farming unions admit that they too had been slow to recognise the change in the public mood towards climate change and the impact that has had on politics.

In a glass fronted office in the heart of the country's capital, Canberra, I met Vanessa Findley, who is charged with running the environmental programme for the country's National Farming Federation. She looked tired and admitted to being harrassed and over-worked as she tried to keep up with the fast-changing political debate on the environment in order to make sure she protected her members' interests.

In her mind, the farming industry there had to understand quickly the significance of climate change as a political issue. And charged with creating 26 per cent of the country's greenhouse gases, farmers had to become pro-active over climate change and make sure they were at the forefront of any debate on the issue. For her, history had demonstrated that farmers are often losers in political decision making, so the risk of not being seen to embrace the new green agenda was too great.

As a result, independent reports have been commissioned by the NFF on the role of agriculture in a new era of environmental regulation and carbon trading. As a strategic position, the broad thrust of these documents makes sense wherever you are farming in the developed world.

First of all, farmers should devise their own set of credible best management practice standards that reduce net greenhouse emissions. The most important aspect of this is to establish a system to measure agricultural emissions that will win consensus across the industry. Secondly, farmers should be able to use this system to benefit from any state or private scheme established to reduce carbon emissions.

The greenhouse accounting challenge

Some Australian farming groups are already ahead of the game in establishing best management greenhouse standards. Perhaps the most successful scheme already underway is that run by the country's Ricegrowers Association from the arable heartland of Riverina in New South Wales.

Growing rice in a drought prone country such as Australia is never going to do much for your public relations profile. So, about seven years ago, Australian rice farmers realised there was a need to reinforce their environmental credentials and became the first agricultural industry to develop a biodiversity and greenhouse strategy.

With the help of government funding, this has now evolved into what they have called the Environmental Champions Programme. There are five levels that participants can decide to adopt (see page 9):

| | |
|---|---|
| Level 1: Basic Industry Standards | Covers basic regulatory requirements and education to increase growers' skills, knowledge and capacity to undertake activities in higher levels. Requirements include chemical training and storage, irrigation education, meeting quality assurance standards, meeting irrigation license requirements and ensuring no net loss of vegetation. |
| Level 2: Planning for Beyond Industry Standards | Involves planning and establishing strategies to move beyond basic industry standards in environmental management. Activities include risk management, water use efficiency, greenhouse training, ground monitoring, off farm drainage, stubble management and whole farm planning. |
| Level 3: Enhancing Biodiversity On Farm | Involves putting plans from Level 2 into practice, together with a large focus on biodiversity conservation. Requirements include farm planning, biodiversity recovery, addressing salinity and soil problems, and undertaking some greenhouse gas reduction activities. |
| Level 4: Trade, Innovation And Eco-Efficiencies | Incorporates a range of activities that provide both environmental and financial returns to growers. Activities include energy efficiency, renewable energy generation and use, addressing waste management, and other greenhouse gas reduction activities. |
| Level 5: Regional Efforts Towards Catchment Sustainability | Involves growers working in collaboration to achieve environmental outcomes for a whole region. Activities may include looking at land use options on a regional scale, engaging in emissions offsets initiatives and salinity trading, and addressing other landscape and river issues. |

The development of the Environmental Champions Programme has not diminished public hostility to what is seen as a water-wasting industry, but in the new green political climate it does seem to be winning them all important plaudits in the state capital, Canberra. Indeed every civil servant I met there held up the ricegrowers as an example of how farmers can innovate and fulfil the government's initiative catchily entitled "Meeting the Greenhouse Challenge".

Meanwhile, those lobbying for the industry's long-term future have been given some great ammunition to take on their enemies. They can now claim that Australian rice growers are the most efficient users of water anywhere in the world as well as the most environmentally aware. They have statistics to hand that show ricegrowers there produce an average of 0.9 tonnes of rice for each megalitre of water used, which they say is 50 per cent more efficient than the world average.

More importantly, the rice lobby can now argue that should the government decide to stop farmers from irrigating their crops and so let the industry die, they will be increasing rather than reducing the country's carbon footprint as rice will have to be imported from less efficient producers elsewhere in the world.

Interestingly, rice growers themselves show genuine enthusiasm for the scheme – around a quarter of them have signed up to the voluntary Environmental Champions Programme in just two years. No doubt, this is partly because they see the real need to promote a positive image as public hostility puts the future of their industry in jeopardy.

But what seems to have made a real difference to the scheme's success is the decision by those organising the programme to emphasise and encourage the need for small local groups to discuss and offer solutions to each other's greenhouse issues. The idea is that the greenhouse scheme should not compromise production, but offer farmers the opportunity to look at management techniques differently.

Yet with rice production last year down by around 90 per cent because of the drought, these meetings have achieved a significance far above their original objectives. Those involved now lend each other emotional support as they try to get through difficult times.



A biodiversity meeting of rice growers at Caldwell, NSW

The Greenhouse Scorecard

Beyond this, the scheme has undoubtedly won support because it is very user friendly. Within the programme, useful self-assessment computer tools have been developed, including a Greenhouse inventory scorecard. This allows you to enter your agricultural inputs to discover the scale of your emissions.

The beauty of this scorecard is that it is quick and straightforward. It does not pretend to give 100 per cent accuracy, but it raises awareness of emissions, and so helps in making business decisions. And this is important. Reducing emissions is all about being more efficient and so saving on costs. The less nitrous oxide released into the atmosphere, the more effective you are being with the way you spread your fertiliser.

At present, no such simple tool is available for measuring emissions in the UK. The East of England Development Agency has recently agreed to fund the CLA and Savills to develop an internet based carbon calculator for agriculture. One just has to hope that it is considerably less complex than the CLA's initial programme, Climate Accounting for Land Managers, for which you needed a degree in maths before one dared to tackle it.

This is nobody's fault as it is an extremely complex issue. Put two scientists in a room to discuss the issue, as I found when I organised just this at the University of Melbourne, and you will find little consensus.

What I can tell you is that for all the equations and scientific equipment, it is impossible to be entirely accurate on how much nitrous oxide is given off by fertilisers, so much depends on conditions and circumstances at the time of application. The IPCC has put a figure of 1.25 per cent of fertiliser turning into nitrous oxide, but all scientists I met admitted this was debatable as the research is based on modelling under certain conditions and circumstances.

China and the greenhouse challenge

Probably the best example of the potential financial benefits of carrying out a straightforward greenhouse inventory and using the information to consider new ways of reducing emissions has been seen in the plains of Northern China. The University of Melbourne, with backing from the Chinese and Australian government, has undertaken a five year programme in the province of Fengqiu to look at how to reduce water and fertiliser use in agriculture there.

The circumstances they faced were far from favourable. In China, there are many mouths to feed, and politicians have traditionally rewarded those producing the largest yields. This has created a culture where farmers, usually working a small plot, see fertilisers as their only solution to improving profits and winning all important political kudos. As a result, they were putting on an average of between 500 and 600 kilogrammes of urea per hectare.

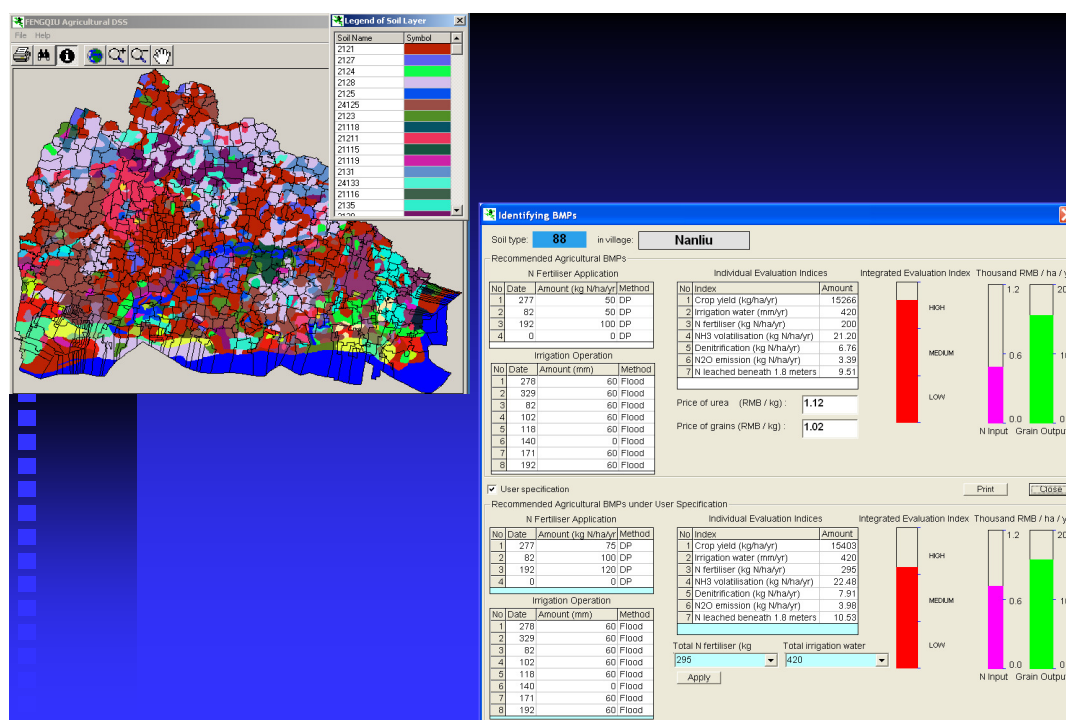
Field trials carried out by the team led by Dr Deli Chen suggested the plant was recovering just 30 to 35 per cent of the nitrogen input, and that 40 kilogrammes per hectare per day was being lost into the atmosphere. Not only was this bad as far as nitrous oxide emissions were concerned, but it also meant farmers were throwing money away.



Dr Deli Chen and colleagues measuring nitrous oxide emissions in China

To try to re-educate farmers, the University devised a computer programme that detailed the specific soil type for every village in the region. They were helped enormously in doing this by the fact that the Chinese government between 1979 and 1986 had carried out a soil plan of the whole country to look at its different qualities and properties. Scientists from Melbourne University then overlaid this with around a hundred or so management options.

As a result, a farmer can click on his village to gain his land's soil type. He can then choose one of the options – for instance putting 300 kg of fertiliser in late spring rather than 400kg in early spring - and is given a graphic demonstration of both its economic and environmental consequences.



Computer interface devised by University of Melbourne allowing Chinese farmers to find their farm and soil type on map to left and then add management options on right-hand screen to see what the impact will be on their farm.

Educating the farmers in this way has had pretty dramatic results. In the region, there has been a 25 per cent savings in fertiliser since the scheme was launched, but no corresponding fall in crop production. Indeed, yields have been maintained and, in some cases, exceeded their previous rates. Meanwhile, the farmers now find themselves being congratulated for reducing their nitrous oxide emissions by a central government feeling the heat of international pressure to tackle greenhouse gases.

Yield – the holy grail

Though farming in China is very different from the UK, there are similarities in the culture. Yield here as in China has traditionally been seen as the holy grail – the way to define yourself as successful. Name me a farmer who doesn't like to over-exaggerate the size of his crop, and why not? After all, it should mean bigger profits. Fertilizers have been the key to unlocking those yields, but would farmers be better served if they demonstrated as an industry that they understood that times are changing and that they need to stand back and reassess the way in which some inputs are being used?

This has financial merit. After all, with the cost of fertilisers only increasing, the economic argument as to how much fertilizer to use is becoming much more finely balanced. A recent HGCA funded project, for instance, suggested that there had to be at least a £13 per tonne premium if growers are to justify the higher nitrogen requirements of modern high yielding milling wheat. Clearly this matters less in the current heady times for wheat prices, but in the dark financial days of a just a year ago it was significant.

And being willing to review fertiliser use certainly makes political sense. We are all aware that regulation of fertiliser inputs by DEFRA is becoming ever more stringent. Plans are already on the table to increase the area farmed as a Nitrate Vulnerable Zone in England from 55 to 70 per cent. Water quality rules also look set to be tightened after threats from the EU to impose fines on England if nitrate levels in water do not decline further. A proposed action plan suggests, among other things, a limit of 170 kg a hectare per year of total Nitrogen from manure and extended closed periods for fertilizer applications.

And this trend towards ever greater regulation on inputs looks set only to tighten further in the future. Under these circumstances, there is surely a real need to be seen to be questioning long-held thinking on fertilisers rather than being defensive over the issue.

Farming groups have done a good job in recent years in altering public perceptions of farmers from “environmental terrorists” and “subsidy junkies” to “custodians of the countryside”. But this could be threatened by appearing intransigent on the issue of how to mitigate the greenhouse gases created by fertilisers. If Gordon Brown wanted to raise extra money through a fertiliser tax, he would have some decent statistics on the potency of nitrous oxide emissions to spin in order to portray farmers in a poor light.

And Mr Brown might soon find the public less sympathetic to farmers than they have been in recent times. The Organisation for Economic Development (OECD) recently published a report suggesting that farm commodity prices will rise by another 20 to 50 per cent over the next ten years, primarily because of biofuels. For the average person that will translate into their shopping being more expensive and nobody will look so kindly on an industry seen to be benefitting from their plight.

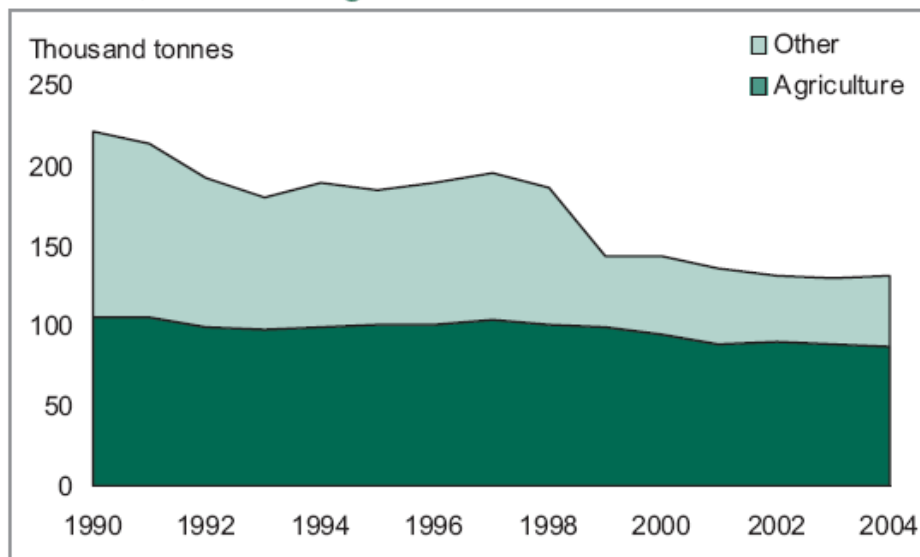
All this comes at a time too when there are increasing questions from the green lobby and some academics about how environmentally friendly biofuels really are, in part because of the amount of fertiliser put on oilseed rape and the likes. Perhaps the most significant criticism came in a report published in September by a group of eminent international scientists – one a Nobel prize winner. This has calculated that rapeseed and maize biodiesels produce up to 70 per cent and 50 per cent more greenhouse gases respectively than fossil fuels. The basis for these calculations was a conclusion by the research team that three to five per cent of the nitrogen in fertiliser was converted into nitrous oxide. No surprise then that one of the report’s final recommendations was a call for governments to do more to regulate against such emissions if they really wanted to promote certain biofuels.

On top of this, production of cereals and oilseed rape for biofuels in Europe is unlikely to be able to compete on economic terms with soya bean and palm oil production. If the biofuels industry here is to thrive in the future, it will need a huge amount of taxpayers’ support to offset this challenge. The more the production of energy crops can be portrayed as environmentally friendly, the more likely it is that the industry will win financial support from governments and the voting public.

How to tackle the greenhouse challenge

The first thing to say is that UK agriculture has already proved successful in reducing its emissions. According to DEFRA's Agriculture in the UK 2006 (see below), nitrous oxide emissions were down 12 per cent in the 10 years leading up to 2004, methane down 12 per cent and overall energy down 25 per cent. You can be sure that an oil company or supermarket would be loudly and proudly telling the wider world about this as they buff up their green image.

Chart 15.10 Nitrous oxide emissions by source 1990 to 2004; United Kingdom



Source: Netcen, Defra e-Digest of Environmental Statistics

The industry can still take advantage of such statistics. But alongside them, it needs to show a long term strategy to enhance this environmental success story. So what should this be? First of all, agriculture needs to devise a greenhouse calculator so farms can work out their emissions. This needs to be kept simple and user friendly. Though this might not provide total accuracy, evidence from Australia and elsewhere demonstrates that this would still prove incredibly worthwhile in demonstrating the industry's good intent with regard to climate change as well as helping farmers establish a measurement for understanding the task at hand for tackling emissions.

Such a calculator need be neither expensive nor time consuming. A business energy audit of diesel, electricity and other fuels etc would be straightforward as bills would give information on quantity used. This can then be multiplied to give carbon dioxide emissions. A formula can also be reached on fertiliser tonnage to give an idea of nitrous oxide emissions. There would have to be an agreement on the rate to be used to calculate these emissions, as there will never be an entirely accurate one-off figure. Similarly, agreement would have to be reached beforehand on the most accurate figure for carbon sequestered through activities like direct tillage, ploughing-in stubbles etc, but more on that later.

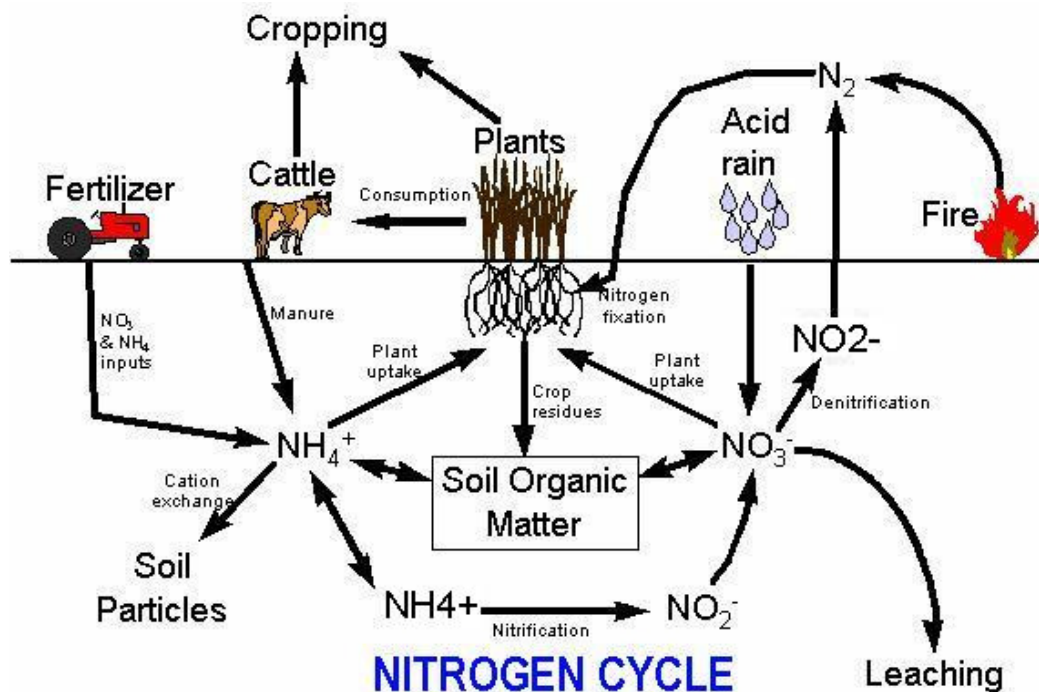
Once a consensus on a greenhouse calculator is established, industry management standards that reduce net greenhouse emissions while optimising production could be developed. These could work at a number of different levels.

Those who sign up at the most basic level would be encouraged to make grain stores more energy efficient, switch off lights and improve insulation. On the land, they would have to review ways of reducing their fuel consumption and examine management techniques that could result in reducing nitrogen use.

Those involved in the higher levels would be expected to implement these management techniques. They would also be exploring alternative energy sources, both for buildings and farm machinery. On the land, they would use minimum tillage, keep crop residue covers, use crop rotations that reduce the need for inputs as well as conserving soil carbon sinks. There would also be incentives to develop ways of marketing these conservation practices as part of a trading scheme for carbon emissions.

So what sort of management techniques are we talking about? Well, taking fertilizer practice as an example, there is plenty of research already underway into how to cut its use without sacrificing yield. Organisations like ADAS and TAG have a range of trials looking at how crops can be managed differently. Some are examining the impact of splitting fertilizer applications more according to growth stages, others the effect of moderating canopy growth and others still whether clover can be used as an alternative nitrogen source to conventional fertilizer. And so the list goes on.

Certainly, there appears to be plenty of room for more efficient practices. It has been shown that in the nitrogen cycle (see diagram below), agriculture has relatively small emissions in the nitrification part – typically between 0.5 and 0.8 per cent, but much larger emissions in the denitrification part – some suggest as high as 5 per cent. This should mean that if there is only enough nitrogen available to meet the plant's needs, then there will be no nitrogen left to go through the denitrification cycle.



Maximising plant uptake and minimising nitrogen loss by synchronizing nitrogen supply with plant demand is a complex science. If it was straightforward, farmers would already be doing it. However, the farming industry needs to show it is actively encouraging and supporting the scientific communities' research in these areas.

Meanwhile, greater soil testing would help to match nitrogen supply with crop demand more accurately. Tremendous variation in soil nitrogen supply has been found in fields with similar soil types or even in the same field in different years as a result of previous land use. However, many farmers do not adjust their rates of nitrogen application to allow for the differences in the supply of indigenous nitrogen. This is partly because there are very few research trials of soil management techniques being carried out for the farmer to draw on.

Whatever techniques are agreed on, it is essential that the industry takes the initiative and devises them. Farmers have already demonstrated that they are able to regulate themselves – the Voluntary Initiative to minimise the environmental impact of pesticides being perhaps the most striking example. To develop their own green management standards not only would allow the sector to make sure all measures introduced have been properly evaluated, but it would also show agriculture as in step with the thinking of the public at large, enhancing its image as “custodians of the countryside”.

Winning industry support

The question is how do you persuade farmers to embrace such a scheme? If further outside regulation is to be avoided, a significant proportion of the industry needs to be seen to be involved in the scheme. However, the reform of CAP has left them unsurprisingly wary and cynical of new initiatives. As a result, somewhat nebulous incentives – such as the need to self regulate rather than be regulated and to portray themselves in as green a light as possible – may well not be enough. A financial carrot, on the other hand, would obviously help.

And there is every reason why the government should be lobbied to support such a scheme financially. DEFRA has made it clear that it is keen to put more CAP money into environmental projects, and this scheme would help in their ambition to reduce carbon dioxide emissions and to be seen to be doing so. Carrying out a greenhouse audit and volunteering to sign up to reducing emissions through management standards should become part of a scheme similar to the Entry Level Scheme. So long as the industry has played a significant role in devising the management practices for such a programme, then it could be overseen by DEFRA.

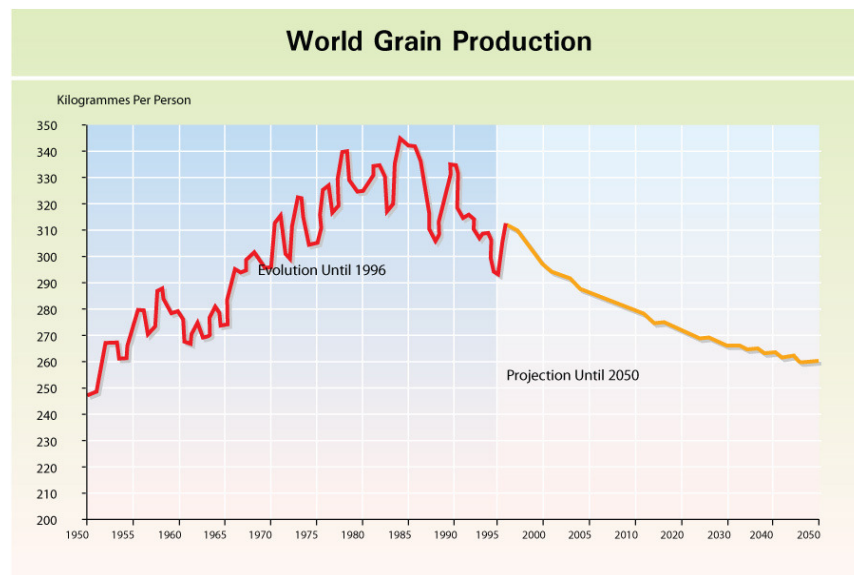
In addition, if the farming community is lobbying for financial help in bringing about something that has a clear environmental benefit, then it makes it more difficult for authorities to bring in outside schemes. I believe that is why so many multinationals, that spend many millions on future strategy, are now embracing the green cause and being pro-active in considering environmental implications. If farmers had initiated a review of fertiliser practices some years ago, would the industry now be facing the ever tightening regulations of DEFRA's RB209?

There are other means that the government could also adopt to help farmers tackle emissions, such as helping to subsidise more efficient products like controlled-release fertilizers or inhibitors. These have a theoretical advantage over other, more knowledge-intensive forms of fine-tuned nitrogen management in the sense that the knowledge is “embedded” in the product to be applied. The rate of release of nitrogen from these is controlled by surrounding the fertilizer with a coating which acts as a diffusion barrier. Indeed, large reductions in nitrous oxide emissions have been achieved using polyolefin coated ammonium nitrate, ammonium sulphate and urea.

The only problem is that controlled-release fertilizers are generally three to ten times more expensive than traditional fertilizers. However, South Korea of all places has demonstrated a solution to this particular problem.

Traditionally one of the heaviest users of fertilizer in the world, the South Korean authorities became alarmed at what their highly intensive agriculture was doing to water supplies and the land. Looking for a solution, they found through tests that slow release fertilizers were about 25 per cent more efficient than traditional brands on the country's paddy fields. So, because the cost of these newer fertilizers was around 50 per cent more than traditional ones, the government agreed to subsidise their cost by 25 per cent. This left the farmer paying an additional 25 per cent, but recouping it because the new fertilizer was far more efficient.

Again, if the UK government is so earnest in its desire to cut greenhouse emissions, it could do worse than give this option serious consideration. After all, if the climate change predictions they are working to prove to be true, there will be significant shortages of grain (see chart below), and farmers here will be under pressure to produce as much as they can. As a result, levels of fertilizer used will need to be maintained.



Courtesy of Worldwatch Institute, New York

Plant breeding and climate change

Beyond improving farm management techniques and adapting fertilizer use, the other most obvious way to mitigate greenhouse gas emissions in arable farming without damaging yields is to look at plant breeding.

With the increasing reliance on fertilisers over the past forty years, plant breeders have concentrated on the production of varieties that will deliver the highest possible yield to persuade farmers into buying them. All are grown under the highest input conditions in order to produce these tempting tonnages. Until recently, little or no resources have been given over to which varieties excel with relatively modest levels of nitrogen.

Yet, the increasing regulation imposed on fertilizer use through Nitrate Vulnerable Zones and the likes makes this increasingly important. In the future, varieties that can still thrive using relatively low inputs could offer additional financial incentives in the future. After all, with Tesco's plan to detail the carbon output of 70,000 odd products, it may well not be long before a premium is available for wheat that can demonstrate its small carbon footprint. Meanwhile, biofuels that can be produced with less greenhouse emissions will only benefit the future of energy crops.

Some seed companies, sensing the future, are already working on this. They are looking at different cereal varieties to find out both what produces the highest yield and which loses the least yield when less nitrogen is put on. Scientists funded by DEFRA, meanwhile, are focussing on the biological question of what traits and genes are responsible for the ability of certain wheat lines to produce more yield for each kilogramme of fertiliser applied.

In the United States, researchers are showing that plant breeding has the potential to bring about a profound change in how we farm and deal with the environment. At Washington State university, for example, they have been working for more than a decade on something called perennial wheat. This plant requires ploughing only once every three to five years and prevents dust storms, stems soil erosion and even absorbs carbon to help mitigate climate change. By crossing wheat with wild grass, they have already successfully cut out the gene that convinces a plant to die. The problem now is to produce wheat that can maintain decent yields over a long period of time.

Should such a variety be successfully developed, it is estimated that it will lower a farmer's fuel costs by around 75 per cent. A crop on the ground throughout the year is also predicted to bank substantially more carbon than a field that is ploughed every year. The problem is that, because of the slow nature of such breeding programmes, researchers at Washington State still believe they are years away from replacing annuals with perennials.

Elsewhere, scientists at the John Innes Centre near Norwich have discovered how some plants create their own nitrogen. Leguminous crops, like peas and beans, produce their own nitrogen by capturing it from the air through root hairs. The scientists have revealed that the root hairs are able to detect microscopic soil-borne bacteria. A chemical signal is sent from the root hair to the bacteria to trigger nitrogen root nodule production. These nitrogen nodules, which are only formed when the plant detects the bacteria, are essential for nitrogen fixation.

The research team now have a good understanding of the process which activates nodule development, a prospect which has the potential to reduce the amount of fertilisers needed. By triggering nodulation in legume crops by manipulating a key gene, the team believe that they are part of the way to allowing nitrogen fixation in crops, such as wheat and barley. If the crop can form nitrogen nodules without the presence of soil bacteria, then the first step to transferring the process to other non-legume crops has been achieved. Needless to say, natural plant nitrogen fixation would radically alter the need for inorganic nitrogen fertilizers.

"If we could get crops like barley or rice to fix their own nitrogen, it would revolutionise food production throughout the world," Dr Giles Oldroyd told me in his laboratory at the John Innes Centre. "The process could help to feed the world because every plant could grow its own nitrogen. You could say it has been the Holy Grail of plant science."

The problem is that the Holy Grail of plant science is unlikely to win popular or political support. The acceptance of genetic engineering on food commodities is still a long way off and such discoveries will always become mired down in endless problems and concerns over unpredictable biological side-effects. Indeed, I believe the only way that GM is likely to be reconsidered is if there are severe food shortages and starvation over a period of time – such as the Intergovernmental Panel on Climate Change is predicting for 2050!

While the farming industry needs to tread carefully when taking a position on this brave new world, it does need to be seen to be encouraging and championing more modest attempts to use plant breeding to reduce our dependence on fertilizers. If the industry can demonstrate that it is trying to change the prevailing culture on inputs, then that has to give it a more effective platform from which to fight any further attempts at regulation. Not only that, the greener the industry portrays itself the stronger position it will be in to benefit financially from global and national attempts to curtail greenhouse gases.

Carbon – the new global currency?

Over the last few years, governments have come to realise that incentives are needed to persuade people and companies to reduce their carbon emissions. The growing consensus on the need to offer financial carrots means that the global market in what is known as carbon trading looks set to boom.

And this emerging market is already developing quickly. Last year global trading in carbon credits tripled to £15 billion. There are many City institutions now trading in the market and trying to buy their way into it as they see the potential for profit. So, how does carbon trading work?

Carbon trading is seen as a market based alternative to either direct taxation or a "command and control" approach which would directly impose emission limits. Under the scheme, governments issue permits to companies allowing them to emit a certain level of carbon dioxide. If companies emit carbon dioxide levels above their allowances, they have to buy permits from those emitting below their allowable levels.

As part of the trading system, the cap for emissions is gradually lowered, increasing the financial burden for the heavier polluters and theoretically forcing them to become more energy-efficient. The EU already has such a scheme in place, the emissions trading system, covering sectors such as power generation, steel, glass, cement, ceramics and paper. However, it has been of little worthwhile value because governments initially set over-generous emission levels so companies have had to make no real cuts in energy consumption.

Currently, agriculture in Europe plays no part in the EU's trading scheme. Under the Kyoto Agreement, there is virtually nothing – bar reforestation – that agriculture can do to be involved. The reasons cited for the exclusion of land based carbon sink schemes are that there are too many scientific uncertainties over their permanence and that they have inferior long-term contribution to climate change compared to reducing emissions from industrial sources.

On the other hand, in the United States, the main country not to have signed the Kyoto Agreement, things are very different. There, basic agricultural practices such as direct tillage are seen as suitable carbon capture techniques, and so are included in voluntary trading schemes mainly run through the Chicago Climate Exchange.

To discover how these work, I took a flight to the bleak plains and endless fields of Washington State in America's North West. There, I met Karl Kupers, an innovator who brokered the first carbon credit lease agreement between farmers and an energy company. His family have run a 2,300 hectare farm, where in the mid 1990s he became one of the first to adopt direct drilling practices.



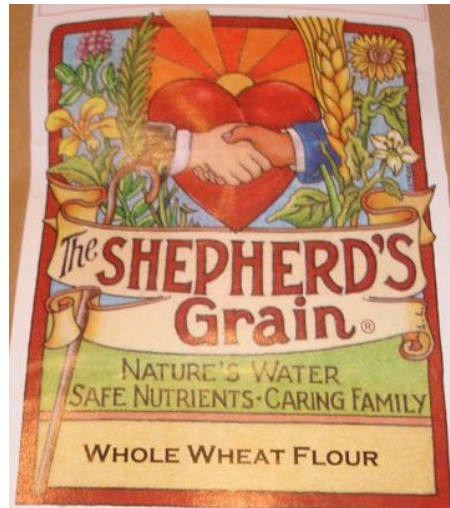
A natural enthusiast, Karl Kupers decided to set up the Pacific Northwest Direct Seed Association (PNDSA) in 2000 to encourage the development and adoption of direct seed cropping systems more widely through the state. Two years later, it became the first group in North America to compile a register of direct seed acres available for a Carbon Offset Trade. These acres were committed to be direct seeded for 10 years and the stored carbon was then marketed in the form of a lease, which was subsequently bought by Entergy, an energy producing company based in New Orleans.

Under the agreement, the PNDSA was paid a total of \$75,000 dollars for a total of 30,000 tonnes of carbon dioxide, or 0.55 metric tons of carbon per acre per year. In return, the Association developed an agreement with 77 grower members representing 6,470 production acres to meet its obligation with Entergy. That agreement contained the definition of direct seeding techniques that would be used to verify sequestration.

The contract also included other necessary requirements and penalties to protect PNDSA. The PNDSA has the ability to solicit additional acres if an existing producer defaults, and growers were restricted to a maximum of 100 acres to spread the risk of default and to protect the producers from committing too many acres too early in the development of the carbon sink market. The acreage is monitored and verified as direct seeded by local conservation groups.

Even Karl Kupers admits that it is not a great deal of money for the growers. But he believes it is a major step toward a new agribusiness model in which farmers get paid to do things that are good for their operations anyway.

Indeed, the formation of the Direct Seed Association has allowed him and its other members to develop a very profitable flour brand, known as “Shepherd’s Grain”. This promotes the carbon-storage activities of the farmers involved and tells consumers that by buying their flour at a premium of more than 10 per cent over other brands they are helping to preserve the planet. These green credentials have helped sales to grow sharply in the major West Coast cities of San Francisco, Seattle, Portland and Los Angeles.



“My business is marketing this verifiable environmental aspect of our management practices,” he told me. “We tell people, ‘You’re a food activist when you buy our product.’ That sells. And it’s real.” To enhance its sustainability credentials, each bag of flour includes the identity of the Pacific Northwest Direct Seed Association farmer who grew it. Kupers is in little doubt that sales have been helped by stressing how the products sustain local farms and their quality of life.



How relevant is this to British farmers? At present, not at all. After all, there are few scientists – let alone environmental lobby groups – that would give their blessing to a scheme that allows carbon credits to be sold for a carbon storage practice that only runs for ten years. Because as things stand, the farmers in Washington State can return to traditional plough methods once the contract is fulfilled and, by doing so, would release any additional carbon that had been stored by ten years of direct tillage.

But next year will see the election of a new American President, and the general consensus is that the next occupant of the White House is set to take a completely different stance from George Bush on the issue of climate change. More likely than not, this will result in the US signing up to the successor to the Kyoto Agreement. But, there will be much give and take surrounding these negotiations and a suggestion that America will be pushing hard for agricultural carbon sinks to be allowed into any global trading system as they seek to keep that influential lobby sweet.

And these discussions will be happening at a crucial time for the future of emissions trading schemes around the world. In Europe, a radical rewrite of the current carbon trading scheme is on the cards as this infant project tries to establish some sort of credibility because, despite running for close on three years, it has yet to cut carbon dioxide in Europe. As a result, much tougher capping levels are likely to be imposed.

At the same time, the scope of emissions trading schemes is expanding as the consensus grows that the market driven “cap and trade” system is the most effective tool for cutting greenhouse gases. Governments are now looking to set up their own national systems for smaller polluters, and agriculture’s role within these is up for debate.

Indeed, in May, the New Zealand government took the country by surprise by announcing that it was going to introducing a trading scheme from next year, and agriculture, which is responsible for around half the country’s emissions, was going to be part of it. At the time of writing, the government had still to announce the details of its plan and whether farmers might win a couple of years reprieve from paying for their carbon.

But the short period of time between the announcement of national carbon trading and its launch has left those representing New Zealand’s farming industry with little chance to lobby the government before the conditions of the scheme are drafted. With time so tight, they are pushing hard for worthwhile mitigation options from the government as the industry feels there are few ways that they can reduce on-farm methane and nitrous oxide emissions, giving them little room for manoeuvre when the new price-based regulations are introduced. As a result, they want research to form the basis of any long term plan for agricultural emissions. To this end, something called the Pastoral Greenhouse Gas Research Consortium, a body part funded by the government and by farmers through a levy system, has been established to find potential solutions.

In contrast, farming groups in Australia have been given the luxury of knowing they have until 2011/12 to prepare for the launch of their country’s national trading scheme. Details of which industries will be involved in this have yet to be finalised, but two independent reports commissioned by the agricultural sector have made clear the importance of being in on the design of any such scheme in order not to be unfairly disadvantaged.

Interestingly, the latest of these reports recommends the establishment of voluntary industry management standards as the best way for the sector to reduce greenhouse emissions. Those signing up to the scheme, it suggests, would then become eligible for an emissions abatement payment from the Australian Government. How much of a financial incentive this would be would depend on the prevailing price of a tonne of carbon dioxide within the national emissions scheme. Why should the government do this? Because they could take these emissions savings and deduct them from the country's calculated national greenhouse inventory, so reducing the international pressure on them.

Back in the UK, the Labour government has been leaking its proposals to create a national carbon emissions trading scheme covering supermarkets, local authorities, and other organisations not covered by the existing EU emissions trading scheme. With the ambitious target of cutting the nation's emissions by 60 per cent by 2050, who is to say that this "cap and trade" scheme will not eventually be rolled out to cover agriculture? After all, it is responsible for seven per cent of the country's emissions.

The fundamental problem for agriculture in pressing its case for a role in any carbon exchange scheme is the difficulty in measuring not only its own emissions, but also what carbon it can sequester or take in from the earth's atmosphere.

Like the thorny issue of how much nitrous oxide is emitted through fertilisers, the potential of soil for carbon sequestration divides scientists and academics. At the University of California in Davis, one professor demonstrated to me how ploughing released carbon into the atmosphere, so correspondingly direct tillage was able to retain that carbon. A short walk down the corridor, and another showed that any such carbon gain from direct tillage was temporary, so making a futile contribution to saving the planet. The one thing that became very clear is that conditions and circumstances surrounding any agricultural operation can alter any scientific analysis in this particular area of research.

However, researchers at Montana and Colorado State Universities now believe that they have developed a soil model that can be used accurately to estimate carbon levels in soil under certain climate and land conditions. The Century model estimates soil organic carbon content and soil organic carbon change using soil texture, weather and farm management information. By testing land in Montana, they found that the model was accurate in its measurements over a period of time.

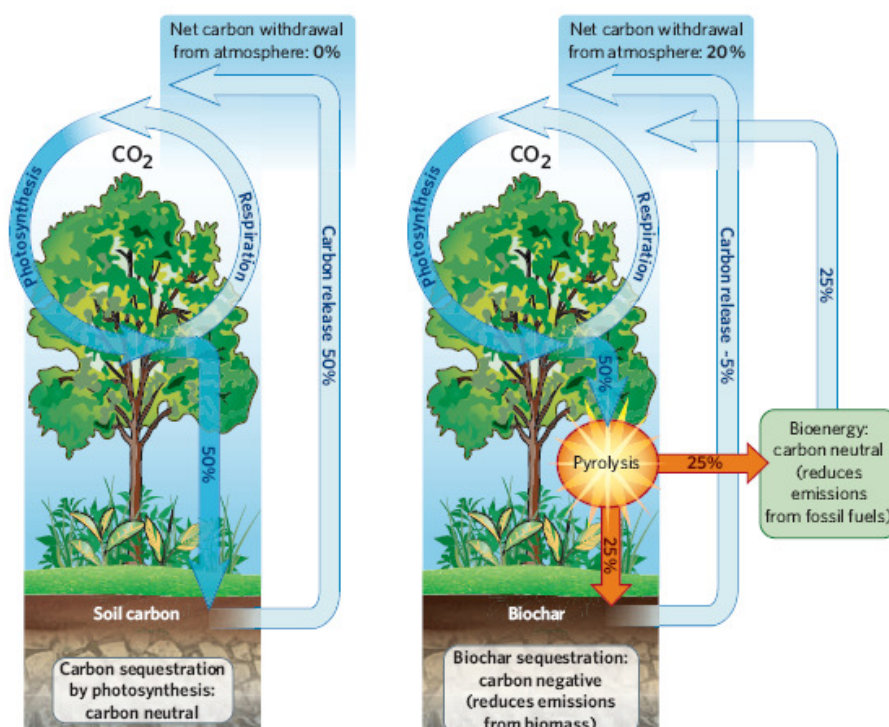
The value of such work for farmers cannot be underestimated. If scientifically proven benchmarks can be established, then there is no reason why farmers should not be involved in carbon trading. Unfortunately, though, the texture of land in Montana will differ greatly from other US states, let alone other countries. But if the research is developed for specific soils that prove the value of soils in carbon sequestration, then there is no reason why farming should not play a role.

Indeed, once recognised benchmarks are established, there is a range of new techniques being developed that could revolutionise the way soil is viewed as a carbon sink. Perhaps the most interesting of these is "agrichar" or "biochar" sequestration.

Black is the new green

Agrichar or biochar is a charcoal by-product of a process known as pyrolysis in which trees, grasses or crop residues are burned at a high temperature in the absence of oxygen. The other product of this process is bio-oil, which is mixed with a selection of oxygenated hydrocarbons that can be used to generate heat or electricity.

Because the agrichar does not readily break down, it could sequester for thousands of years nearly all the carbon it contains, rather than releasing it into the atmosphere as carbon dioxide. Indeed, those promoting the practice go as far as saying that the process is carbon negative as it removes decomposing plants from the atmosphere and so prevents them releasing carbon dioxide back into the atmosphere:



Along the way, it would boost agricultural productivity through its ability to retain nutrients and moisture. Indeed, the use of Agrichar in soils mimics the Terra Preta ("dark earth") soils of the Amazon Basin, which have sequestered high quantities of carbon for thousands of years and have dramatically improved soil fertility and sustainability without chemical inputs.

As with many new technologies looking at how to mitigate climate change, pyrolysis and agrichar are still in their infancy. As a result, many questions still remain. It is not a uniform product, for instance, and nobody is sure what types of biomass and production methods work best. This makes it difficult to understand how financially viable it might be.

But it does illustrate future possibilities for farmers considering their role in any carbon trading scheme. Accounting for agrichar is much more straightforward than with other soil sequestration methods. No complex predictive models or analytical tools are required, and the source of biochar additions can be identified by soil analyses if needed for verification under carbon trading schemes.

In the interim, while these technologies are being developed, farmers do have other assets to stake their claim for a role in any carbon trading scheme; for instance, wood management, long the poor relation in estate and farm management.

Again, the revenue raising potential of this is currently relatively small, but for those wanting to plant new woodland, the opportunities and financial rewards are growing as companies try to use tree planting as a way to show off their green credentials.

Take Marks and Spencer as an example: Its catchily named Plan A strategy (because there is no Plan B), which aims to make the retailer carbon neutral by 2012, includes an extensive programme of planting native species in order to make its furniture deliveries carbon neutral. Under the scheme, which was brokered by the consultancy Forest Carbon, landowners are paid a grant by M&S to manage the young woodlands and to keep them as woods in perpetuity. Besides that, the areas are open to the public, so that shoppers can visit the young trees as they deal with their angst over the carbon dioxide that has been emitted from the delivery of their new dining room table!

Farming in the future and the politics of climate change

So what have I brought home from my Nuffield travels? Well, I am experimenting with direct tillage and assessing its impact on yield, altering the timings of fertiliser applications and carrying out more soil tests to try to be more precise in these applications. Unfortunately, you will have to wait a year or two before I can bring any definitive results on these various trials and they may not be relevant to your land. However, I do firmly believe we can reduce our emissions further without damaging the bottom line.

What I am most clear about is that I, as a farmer, could be facing much more outside regulation in the future. The political debate over climate change has moved and continues to move very quickly, and I fear that the farming community has not realised what this might mean for the industry and, correspondingly, my business. Having been a journalist at the BBC for many years, I have learned the strategic importance of a clear and coherent message and what impact it can make on the wider world.

Farmers need to accept the revolution in political thinking on the environment even if there is a cost involved at the beginning. It is short-sighted to promote the industry's ability to produce bio-fuels as our sole contribution to tackling climate change. To appear to not want to discuss issues such as fertilizer pollution leaves the industry open to the possibility of increased financial costs and greater bureaucracy as well as give ammunition to those wanting regulation of the industry to be tightened further.

However, if farmers can demonstrate that they are conscious of the problem and are actively looking at ways to mitigate it, I believe the industry can keep heavy-fisted regulation at bay. It can devise its own greenhouse options without necessarily jeopardising yields and profits. Most importantly, it will show farming as in step with public opinion and demonstrate that not only do we take our role as custodians of the countryside seriously, but also that we have a central role to play in a major issue concerning all of society.

Recommendations

- The industry must engage more actively in the political debate over mitigating greenhouse gases. There is little point continuing to question the extent and existence of global warming as the idea that man is making the planet warmer has won such wide political and commercial acceptance.
- The industry should be wary of basing its green credentials almost solely on the production of biofuels. Firstly, there are increasing questions over how environmentally friendly biofuels produced by oilseed rape really are. In addition, the fact that farmers are benefiting from the rapid rise in oilseed rape prices places a big question mark in the public mind over whether their commitment to the green cause is purely lip service in order to make greater financial gain.
- The industry needs to establish its own initiative on tackling global warming to avoid greater political and commercial regulation. Big businesses, including supermarkets, understand the importance of appearing green both for their brands and for keeping further political regulation at bay. Farming must realise why appearing green is strategically so important.
- To underpin this voluntary initiative, an agreed and accessible emissions measuring programme must be established.
- Best management practices for reducing greenhouse emissions can then be agreed on. Researching the most effective and practical measures should be funded by crop levies.
- The industry should demand and champion greater research by plant breeders into crop varieties whose yield can be maintained with less fertiliser. The increasing regulation of inputs makes this essential whatever one feels about global warming.
- Once the initiative is established, the government should be lobbied to support any scheme financially in order to give farmers an incentive for joining. If the government wants to take money away from agriculture to put into environmental projects, then this is one way they could do it.
- The industry should lobby to be involved at the outset in any design of a national carbon trading system. History has taught the importance of having a voice in these important decision making processes.
- Finally, the industry needs to develop and promote a clear public message on how it is attempting to mitigate its greenhouse gases. Over the last few years, farming has reduced its emissions, but who knows that? Whatever the cynicism to marketing, image and brand are vital for defining a business. Much better to be seen as “custodians of the countryside” than “environmental terrorists” for promoting one’s agenda on a wider stage!

Thanks to:

Louise Adcock, Environmental Programmes, Australian Ricegrowers Association

Dr Pete Berry, Senior Research Scientist, Sustainable Crop Management, ADAS

Dr Deli Chen, Faculty of Land and Food Resources, University of Melbourne

Cynthia Cory, Director of Environmental Affairs, California Farm Bureau Federation

Vanessa Findlay, Environmental Director, National Farmers Federation, Canberra

Andrew Grant, Managing Director, CO2 Australia, Melbourne

William Horwath, Associate Professor of Soil, University of California, Davis

Louise Jackson, Dept of Land, Air and Water Resources, University of California, Davis

Brett Janissen, Allen Consulting Group, Canberra

Dr Chad Kruger, Centre for Sustaining Agriculture, University of Washington

Karl Kupers, Pacific Northwest Direct Seed Association, Washington State

Dr David Laurie, plant biologist, John Innes Centre, Norwich

Martin Medina, Manager, Turkovich Ranches, Winters, California

Dr Giles Oldroyd, John Innes Centre, Norwich

Dr Gary Richards, Director of National Carbon Accounting System, Australia Greenhouse Office, Canberra.

Dr Bill Slattery, Greenhouse & Agriculture Team, Australia Greenhouse Office, Canberra

Dr Kate Scow, Director, Kearney Foundation of Soil Science, Davis, California

Chris Spangaro, Greenhouse Gas Abatement Scheme for New South Wales, Sydney

Leigh Vial, Australian Ricegrowers Association, Swan Hill, New South Wales

Dr David Viner, Climatic Research Unit, University of East Anglia

Steve Vosti, Agriculture and Resource Economics, University of California, Davis,

Corey Watts, Australian Conservation Foundation, Melbourne

And a particular special thanks to my sponsors, the Oxford Farming Conference and the Royal Norfolk Agricultural Association.

