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a **greenfutures** Special Edition

 **forum for the future**

TOMORROW'S FOOD, TOMORROW'S FARMS

**FARMING
FUTURES**
PROFITABLE BUSINESS IN A CHANGING CLIMATE

Food and Drink
Federation **fdf**
Making a real difference

There's a storm

...and farmers are rising to meet it, says **Jonathon Porritt**.

These are tough and very challenging times for farmers. Against a backdrop of rising input costs, reduced willingness among consumers to pay a decent price, and deteriorating environmental conditions, farmers in Britain and around the world are struggling to make ends meet.

Even in rich countries, the shadow of food insecurity has returned, threatening to bring to an end a golden era of plenty. It had been quite a success story, with agricultural activity focused almost exclusively on ensuring the provision of cheap and abundant supplies of food and fibre. Only in the last ten years or so have the full environmental costs of this cornucopian plenty been brought to light.

For countries with spending power, the reassuring sight of supermarkets brimming with cheap, fresh produce from around the world, irrespective of season, has obscured the realities that lie behind that facade. Where all this stuff comes from and how it got there have been of little consequence to the average shopper – one of the reasons why farming in Britain has been marginalised in the national debate as just another struggling sector of the economy, a world away from its central position as a strategic resource not so long ago. Britain is more dependent on food imports now than at any time since the 1960s. Less than 60% of what we eat is grown here, leaving the nation vulnerable to supply and demand shocks and growing price volatility in international markets.

The possibility that the food abundance we are so used to might come to an end seems almost unimaginable. Yet the pressures now facing agricultural production and food supply are immense. A rising population in the UK (set to reach 70 million by 2030) is part of a global trend in which the same land mass must feed at least 9 billion people by 2050 – three times the global headcount in 1960. And the environment in which this challenge will have to be met is full of uncertainty.

Heading the list of hard to manage risks is climate change – which 38.4% of farmers in the UK consider is already affecting their business, according to a Farming Futures survey in 2010. There is still much debate about what the impacts are likely to be. Extreme weather is in the news, with fires in Russia and flooding in Pakistan, Sri Lanka, Brazil and Australia – the latter after a prolonged

period of drought. Personal tragedy and damage to infrastructure will be compounded by longer-term economic consequences.

Rising temperatures are also expected to reduce yields of many staple crops. A recent modelling study in the US suggests there is a 'temperature tipping point' beyond which crop yields are likely to plummet. One model showed a potential drop of 82% in maize yields by the end of the century. Averaged out, global cereal production could be between 3% and 8% lower by 2050 because of climate change, according to the International Food Policy Research Institute – at exactly the time when we need those yields to be rising. The Institute argues that a rise of only one degree could play havoc with food production.

Getting farmers to think about mitigating and adapting to climate change might seem a forlorn task in such difficult times. Agriculture's emissions currently account for 8% of the UK total, according to the Department for Environment, Food, Agriculture and Rural Affairs (Defra). That may not sound like much, but a business as usual approach will mean that beyond 2020 the sector will contribute 28% of our permitted 2050 emissions. In 2000, the livestock sector globally accounted for 52% of the 'safe operating space' for greenhouse gas emissions. If growth forecasts from the UN Food and Agriculture Organization (FAO) are correct, this could rise to 72% by 2050. With no other industries stepping up to take the pain of additional reductions, farming's carbon and nitrous oxide efficiency will have to undergo a step change if the sector is to deliver its share.

And climate change is just the best known of a raft of environmental challenges confronting the sector. Water scarcity is rising in the public consciousness, though it's been a preoccupation for farmers for some time [see 'Thirsty work', p14]. There's fierce debate, though, over just how much water is involved. One study by The Water Footprint Network claims that 16,000 litres are needed to produce just one kilo of beef. Nonsense, says Eblex, the organisation supporting England's beef and lamb industry. Its own study gives the figure as a mere 67 litres! A lot depends on where in the world the beef is being produced, and certainly there are places where meat is a very thirsty business.

ahead

Photo: Floriana / iStock



There's also the impact of artificial fertilisers on ecosystems to consider. Excessive application of nitrogen to enhance yields has been the primary reason behind the declining water quality of our rivers and lakes, through 'eutrophication', or artificial enrichment. But legislation to regulate how, when and where nitrogen might be applied could drive dairy farmers – who already struggle to get a decent price for their milk – out of business.

All this, of course, is assuming that artificial fertiliser is affordable in the first place. Rock phosphate, the basis of so much agricultural fertiliser, is selling at double its cost in 2006, prompting some commentators to predict 'peak phosphorus' as soon as 2033. Without phosphates, wheat yields could halve by the turn of the century.

This particular 'triple whammy' (input scarcity, declining production and rising demand) can only mean one thing: rising prices [see 'Price tag', p12]. Global food prices in January 2011 were higher than the previous spike reached when commodity prices hit the headlines in 2007/8. The FAO commodity index reached 231 points, outstripping the previous high of 213.5.

Paradoxically, rising resource and food prices might not be all bad news. In an era of cheap food, farmers have struggled to make the case that you get what you pay for when it comes to the quality and sustainability of food production. UK farmers have undoubtedly woken up to the efficiency challenge in energy, fertiliser and water use. For some, rising prices will mean more room for investment, and more motivation to widen the gap between production costs and factory gate prices by driving greater efficiency on farms. New soil management practices, more efficient application of fertilisers and smarter power use can all generate significant savings.

Food retailers are becoming noticeably more interested in their domestic supply chains, and many of them have made announcements in recent months about investing in sustainability on the farms that supply them [see 'Oranges are not the only fruit', p6]. PepsiCo wants carbon and water footprint reductions of 50% on their farms in the next five years; Sainsbury's is investing £40 million in the next three years on increasing the resilience of its suppliers to climate change; and Morrisons has teamed up with the Prince of Wales to set out a blueprint for sustainable farming.

But perhaps the most significant positive trend in the last year has been farming's love affair with renewable energy [see 'Land power', p18]. Despite shock stories in the *Daily Mail* about solar panels carpeting the countryside, and the *Telegraph* moaning that 3,000 British wind turbines stood idle over the recent cold period due to a lack of wind, the level of interest in these technologies amongst farmers remains high: 80% of farmers would like to put solar PV on their roofs, according to a joint survey by Farming Futures and Solarcentury in December last year.

In fact, there's such a blizzard of applications for field PV systems that, bewilderingly, the UK Government may intervene to stop too many solar parks getting the go-ahead.

Farmers are no longer 'on the back foot' when it comes to responding to the challenge of climate change and other sustainability issues. Just a few years ago, 'low-carbon farming' would have meant nothing to most UK farmers; now it's an important driver of new research, innovation and delivered solutions on the ground.

Jonathon Porritt is Founder Director of Forum for the Future.

Photos: craftvision / istock; Bushuev / istock

“We want agriculture and the food sector to be part of a truly green economy”

Our challenge, as set out in the recent Foresight Report on the future of food and farming, is to create a global, integrated approach to food security: one that looks beyond the food system to the inseparable goals of reducing poverty, tackling climate change and curbing biodiversity loss. The Government is determined to show leadership in making that happen.

In the UK, Defra will continue to work in partnership with our whole food chain, including consumers, to ensure we lead the way in demonstrating how agricultural production can be increased sustainably. We need to create the conditions for the UK farming industry and food chain to increase its productivity and competitiveness whilst reducing greenhouse gas emissions, protecting and enhancing the natural environment, and using resources more sustainably. In short, we must ensure that agriculture and the food sector are part of a truly green economy.

The partnership between Government and industry will be essential in achieving these goals. As Minister of State for Agriculture and Food, a key part of my role is to maintain and enhance this partnership. As such, I am committed to providing industry with the opportunities, tools and knowledge they require in

order to take action.

For example, to face the challenge of climate change, we will continue to support the industry as it drives down emissions. This includes investment in world class research and development. We have already committed £12.6 million, in partnership with the Devolved Administrations (Scotland, Wales and Northern Ireland), to improve the UK's Agriculture Greenhouse Gas Inventory. This will strengthen our understanding of on farm emissions, enabling industry to take action to drive these down.

Equally, we are committed to supporting the industry to take advantage of opportunities and plan for threats. This will make farms more resilient in the face of coming changes to our climate, and in particular extreme weather events.

Together, we can ensure that the industry is able to continue to thrive and deliver the essential public and environment services it provides. I look forward to taking up this challenge with you.

Jim Paice MP is Minister of State for Agriculture and Food, Department for Environment, Food and Rural Affairs.



Sunny side up: on-farm PV can be a lucrative complement to traditional farming

Photo: Jan-Otto / istock

Oranges are not the only fruit

...Or are they? Supply now has the upper hand over demand, says **David Burrows**.



Producing a packet of crisps releases around 80g of carbon. But what about its water footprint? Or the impact of vast swathes of potato on local biodiversity? Are the farmers paid an honest price for their crop?

Conversation about how to make food chains more sustainable has often started and stopped with carbon. Climate change has been the big environmental ticket. But PepsiCo,

the maker of the crisps with the 80g carbon label on the pack, is among a number of food retailers looking beyond greenhouse gases (GHGs) to guarantee their future supply.

PepsiCo recently pledged to cut the carbon and water impacts of its key crops – which include oranges for its Tropicana juices, and sugar for its famous fizz – by 50% over five years. Its motive is straightforward. As Richard Evans, President of PepsiCo UK, puts it: these crops make the company its profits. Indeed, without oranges, sugar or potatoes there would be no PepsiCo.

A shortage of such essential crops may be hard to imagine, but it's not an unlikely scenario. "We are only one poor grain harvest away from chaos in the world grain markets," warns Lester Brown, President of the Earth Policy Institute, and author of *World on the Edge*.

Others voice the same concern. "Land is at a premium, weather patterns are unpredictable, pressure on key resources is intensifying – and the global population is rising", notes Richard Mattison, Chief Operating Officer at environmental data producer Trucost. "Companies simply have to develop a better understanding of their dependence on natural resources, and where the risks might come in the future."

Mattison has dubbed 2011 "the year of the supply chain" – and retailers are rising to it. Cadbury's Cocoa Partnership is a case in point. The chocolate company, now owned by Kraft Foods, would be nowhere without

a secure supply of cocoa. But despite our devotion to Dairy Milk, cocoa farming has become less attractive in Ghana, a principal producer. Rural farming communities are migrating to urban areas in search of higher wages, and those left behind aren't getting any younger. The trees are ageing too, and there's a lack of future planning when it comes to planting replacements. Add to this the stress of water shortage and the impact that climate change is beginning to have on harvests, and the risks for Cadbury become very real.

The Cocoa Partnership was set up to support struggling farmers to stick with their crop. It set up schools and demonstration centres in 100 agricultural communities across Ghana, offering advice in efficient land-management and support to develop more sympathetic relationships with buyers – with Fairtrade certification a major goal.

In the past, the motive for initiatives like Cadbury's may have been reputation. Not anymore. As Oscar Chemerinski, Director of Global Agribusiness at the International Finance Corporation, explains: "There is an increased realisation by global agribusiness that their success or failure in the medium and long term is tied to the success of the small farmer, both financially and environmentally."

The implication is a significant power shift in the supply chain, from buyer to producer – and from producer to the crop itself. Alison Ward, Associate Director of Agricultural Sustainability at Kraft Foods, sums it up with the Ghanaian phrase, 'Kookoo cobatanpa': "Cocoa is a good parent; it looks after you."

It's a shift remarked upon by Lester Brown, also. He claims "a new politics of food scarcity" is emerging, driven by low stocks and high volatility. "Exporting countries no longer see why they should negotiate long-term agreements, because it's a seller's market."

So for many food and drink companies, the days when sustainability just meant a one-off zero-carbon superstore, lighter tins of beans and electric lorries are gone. Supply chains are now centre stage. And as they acknowledge their vulnerability as buyers, they're developing a new sense of responsibility for the supply.

Photos: richterfoto / iStock; Elmer Martinez / Getty



Taste the difference

We are what we eat, goes the old adage. So it's high time we knew more about the food on our plates, says **Johann Tasker**.

Spoilt by the constant availability of cheap food from across the world, many consumers simply don't know the environmental, production and labour cost of their diet. And they certainly don't realise they can do anything about it.

Some retailers are taking steps towards consumer education. A little over 18 months ago, Tesco became the first UK supermarket to display the full carbon footprint of the milk sold in its stores.

For Sally Uren, Deputy Chief Executive at Forum for the Future, this is a step in the right direction – "but it must involve more than putting labels on food. What retailers do incredibly well is sell stuff. So there's a real role for retailers to sell sustainability in a positive way."

Today's savvy shoppers need clearer and better information, agrees Sue Davies, Chief Policy Advisor at consumer organisation Which?. According to her research, three in every four people believe that protecting the environment is an important issue when choosing what to buy.

"Even those who consider themselves engaged about these sorts of issues find it difficult to describe what is meant by terms like 'environmental impact'", she says. "Consumers take certain things for granted. They expect their food to be safe, produced to high animal welfare standards and to be good quality. We have to bring all those drivers together while being much clearer about sustainability."

Visual media has a role to play. Take the televised "Chicken Out" campaign by chef and food campaigner Hugh Fearnley-Whittingstall. It raised £75,000 in just two days from almost 3,000 viewers eager to improve poultry production standards. The campaign was a success, explains Andrew Opie, Food Policy Director at the British Retail Consortium, because it offered consumers an easy way to make a difference.

"It wasn't asking people to stop eating chicken or to cook it in a different way, but to think about the way chicken is being produced. We saw a significant switch to free range, which has been sustained."

Johann Tasker is a journalist specialising in food, farming and rural issues. He is Chief Reporter at *Farmers Weekly* magazine.

The more the merrier

Many of us find comfort in a trip down to the local farmers' market to pick up the kind of artisanal foods that are currently the life blood of small-scale farming systems. But could the role of small farmers ever move from the niche to the mainstream?

Wal-mart thinks so. It plans to sell \$1 billion worth of food sourced from 1 million small-scale

farms around the world, and is throwing in some efficiency training for the farmers, too.

So what could 1 million small-scale farmers do for Wal-mart and its 200 million weekly customers that 10,000 large farms couldn't? Answer: create a supply chain that, thanks to its diverse base, is relatively resilient whatever the weather. – *Will Frazer*

The Food and Drink Federation has updated its Five-fold Environmental Ambition to reflect this change in focus. It had already driven the industry to cut carbon emissions by 21% against a 1990 baseline, save more than two million cubic metres of water, and reduce food and packaging waste to landfill to 9%. But that's not enough, says Director of Sustainability Andrew Kuyk: "We have to recognise the influence we have on either side of us in the supply chain."

It's an example of how thinking has really changed, says Trucost's Mattison. "Companies are realising that they have the purchasing power to educate their supply chain. It's not just about identifying inefficient suppliers, but working with them – building closer relationships with

A sweeter supply chain: cocoa farmers reap rewards from long-term partnerships



increased transparency."

But despite a trend for buying direct, the vast majority of raw ingredients go through a middle man. So what about commodity companies like Cargill and ADM, which trade millions of tonnes of food every year?

Commodity trading is often the weak link when it comes to sustainability. According to research by consultancy Two Tomorrows, there's a 'mismatch' between the strategies of brand owners and those of the large companies supplying them. It found that only five of the top ten food ingredient companies have produced recent, substantial corporate responsibility reports. "This poses a major challenge for food companies that need to trace where products have come from to meet their sustainability targets", says Executive Chairman Mark Line.

Steven Fairbairn is Head of External Communications on Corporate Responsibility at Cargill. He says the company is aware it has a role to play in developing sustainable supply chains and admits that "we are feeling the market demand for it already". He also recognises that "it's in our interests that smallholders have support ... for the longevity of our business as well". But this alone may soon not be sufficient. As pressures intensify, concrete commitments could be expected of agribusinesses like Cargill, along with their primary processors, as their customers – both manufacturers and retailers – look into their supply chains in scrupulous detail.

Fast-moving consumer goods giant Unilever is one of the more demanding commodity buyers. It buys 7.5 million tonnes of raw materials every year, and has recently set out a target to procure all its agricultural ingredients from sustainable sources by 2020. It simply can't do this alone: the middle men have to be on board.

"Our suppliers know the farmers and we know the suppliers," says Gail Smith from Unilever's sustainable sourcing development team. "That's how the communication channels run. If we are to have any chance of building sustainable supply chains, then there is a responsibility for everyone."

Unilever has developed a new software system to mark its suppliers' performance. The latter often cite the time spent on answering questionnaires from customers further up the chain as a drain on resources. But Smith claims Unilever's Sustainable Agriculture Code cuts out unnecessary paperwork, and "makes it very easy for them to see how they perform".

PepsiCo has also provided its suppliers with an energy assessment tool to keep them up to scratch. But they shouldn't just see it as a chore, argues Rob Meyers, the company's Group Manager for Environmental Sustainability: "There are tangible financial benefits to reap", he insists.

Paul Simpson, CEO of the Carbon Disclosure Project, agrees: "For the big supermarkets, 90% of total emissions come from the supply chain. So the big savings, in both carbon and cost, can come from their suppliers. Of course, they'll expect some of that cost saving to be passed on, but the strength of the relationship with their suppliers will improve dramatically."

David Burrows is an environmental journalist with a special interest in food. He has worked with Defra and the WWF's One Planet Food Programme.

Photo: eefauscan / istock



BIG PICTURE THINKING

Systems innovation could put food on the fast track to sustainability, says **Sally Uren**.

The global food system is not sustainable.

A simple truth: one we've known for many years. Yet despite multiple interventions by numerous organisations, progress towards sustainability has been slow.

So, what exactly is the problem? Well, the answer to that is a problem in itself. A diagnosis for the food system spawns a complex, interconnected web of social, environmental and economic issues.

Take the fact that the true cost of food to the average consumer in developed economies has gone down over the last few decades, when the overall cost of living has gone up. For example, 21% of UK household expenditure was on food and non-alcoholic drink in 1970, but by 2008 it had dropped to just 9%. Good news, surely, for families on low incomes? One claim made regularly by the big retailers is that they are, on balance, a force for good, as they have improved access to cheap food for millions.

However, 'cheap food' is not great news for growers in both developing and developed markets. They see their margins squeezed as retailers try to keep prices down. Many simply go out of business – a big social and economic negative. The squeeze on price can also mean that large-scale production processes become the only economically viable option, with well documented negative environmental impacts.

As more and more of our food comes to us via mass production, we, the end consumer, lose the connection with the food we buy. We've all heard the story of the six year old's answer to the question about where do eggs come from? "Supermarkets,

of course!" There are implications for our health, too. The sheer accessibility of cheap food is a known contributor to an ever-increasing burden of chronic disease, and many developing economies have the double burden of vast swathes of malnourished people living alongside the newly obese.

Another big debate raging right now is the role of GM in helping secure global food security. Many rush to extol the virtues of science and technology as the answer to feeding a burgeoning global population, and indeed such solutions will have a role to play.

But if we focus too much on GM as the silver bullet, we'll miss another, much cheaper and simpler solution which is already in our grasp: cutting food waste. A huge amount of food is wasted between harvest and the shop, and shameful skip-loads of the stuff are thrown away by consumers themselves: in the UK alone, around 30% of food that people buy ends up in landfill.

These debates, from cheap food to GM, show how interconnected different parts of the food system are. The good news is that by getting smarter about these connections, and not looking at issues in isolation, we could help shift the food system towards greater sustainability. But we need to ask the right questions.

So, how can retailers engage differently with producers to improve financial returns? The fair trade model shows that alternative contracts can work well right down the supply chain: for growers, by guaranteeing income; for manufacturers, by securing supplies; and for retailers, by proving that they are serious about sustainability and

giving them more 'brand glow'.

How can we connect the end consumer (that's you and me) with the origins of the food we buy? It's an important question. Because if we were more aware of the direct link between the food in our fridge and the livelihood of the farmer down the road, we might (and it's a big might) be prepared to pay a little more, or at least not throw a third of it away.

Of course, what better way to connect the consumer with food than to encourage them to produce some themselves? If not by actually getting their hands dirty, then by becoming involved with one of the burgeoning numbers of community-supported farm schemes [see 'Where skylarks dare', GF66, p44].

The sooner we start thinking about circular value chains, as opposed to long linear ones with the producer at one end far removed from the consumer at the other, the better.

Systems innovation for food gives us an unprecedented opportunity to do three things – reconnect the consumer with the food they buy, redefine the value of food and rebalance the power in global supply chains.

At Forum for the Future, in collaboration with our partners and others in the food system, we plan to get serious about innovation in the food system, in the hope that it begins to accelerate, and stops shuffling, towards sustainability.

Sally Uren is Deputy Chief Executive at Forum for the Future.

Photo: dlewis33 / istock



INTENSIVE OR EXTENSIVE?

Children's books and costume dramas fill our heads with bucolic images of farm life, but land shortages and environmental pressures mean farms have to change. But how? **David Alvis**, a farming consultant involved in setting up a large-scale dairy unit, believes an intensive system is best for both animals and the environment. It's a view firmly rejected by **Helen Browning**, an organic free-range farmer and Director of the Soil Association.

Put simply, what's best: intensive or extensive?

DA: If they're well designed and well managed, intensive farming systems can deliver significant sustainability benefits. They are by far the most resource-efficient way of producing milk or meat. Organic farming has a part to play, but it is a niche industry.

HB: It's not about intensive versus extensive. I'm looking for an eco-intensive system that means producing more than just food from a productive, varied system. We need to look at animal welfare, energy production, carbon sequestration and optimal food production. Diversity is strength.

To feed our growing population, do we need to promote production and profit over the needs of the animal and environment?

DA: Absolutely not. No one is going to make a sustainable return on investment from unhealthy animals under poor conditions. The dairies we propose are designed from the outset from a 'cow comfort' perspective, as well as meeting production and sustainability criteria. They have optimum levels of natural light and ventilation, clean beds, constant access to food and fresh water, and an exercise yard.

HB: No. It's possible to meet all needs. There are some interesting trade-offs if you look just in carbon, methane or climate change terms between different systems and we have to acknowledge that. A free-range chicken will be less carbon-efficient than one that's kept in a battery cage. We have to decide if a lower carbon footprint is the ultimate goal.

Housed animals need to be grain fed which is more environmentally damaging. Surely grass fed is better?

DA: Take the Holstein cow. Grass alone simply isn't an adequate diet for her productivity. But I'm not for one minute suggesting feeding purely prime grains. As ruminants, cows also exploit a lot of the by-products already present in our food system, such as sugar beet pulp and certain grains that have little or no value to humans.

HB: The less you rely on grains to feed animals the better. Grassland is one of the best ways to sequester carbon. Grass provides omega 3 and ruminants are designed to eat it – it's the most sensible approach.

Are there technological fixes on the horizon that will change the way we view intensive/ extensive systems?

DA: There's a lot of technology around animal monitoring which allows farmers to observe and manage cow wellbeing and comfort without disturbing the animal. This could help alleviate people's concerns about welfare in intensive systems.

HB: We already have the technologies we need to feed the world sustainably. The problem is that we're always looking for new products rather than new approaches. I want to know how we can move to full ground cover systems so we never plough the land but maintain a leguminous cover into which we plant the cash crop. That kind of breakthrough would revolutionise agriculture and deliver for biodiversity, soil protection, carbon sequestration and disease control.

A tale of two systems

Intensive farming has traditionally involved high inputs of capital and labour, and high use of pesticides and chemical fertilisers. Agricultural mechanisation, monocropping, or housing as many animals as possible on the land make for impressive yields, but often at a significant cost to biodiversity, soil fertility and animal welfare.

Extensive farming uses small inputs of labour, fertilisers and capital, relative to the land area being farmed. Examples include sheep and cattle grazing widely in areas with low agricultural productivity, and organic farms. Yields are low, but the focus is on maintaining the long-term health of the ecosystem, so that it can be farmed indefinitely without recourse to artificial inputs.

Photo: LUGO / iStock

LET THEM EAT ... WHAT, EXACTLY?

When we seek out nutritional advice, it's usually because we'd like to lose a kilo or two. But which plan is best for the planet? Is there a sure fire way to keep both our bodies and our surroundings fit for the future? And does it begin with a 'V'? **Simon Fairlie**, author of *Meat: A Benign Extravagance?*, and **Jen Elford**, Head of Research and Information at The Vegetarian Society, battle it out.

Which diet is best in the long-run?

SF: We need a diet with less meat than we eat at the moment in the West, and better access to healthy food in developing countries. A certain amount of meat comes environmentally free of charge as a by-product of the rest of the agricultural industry. We'd be crazy not to eat it.

JE: The most sustainable diet meets our basic nutritional requirements with the lowest possible environmental impact. So that points to grains, nuts and pulses as primary sources of protein, carbohydrates and healthy essential fats.

As people get richer, they eat more meat. Take India and China. Is it a problem?

SF: Of course we can't deny countries the right to develop. But we shouldn't encourage Western diets. Our meat intake is excessive: we need to reduce it by about half. China has a high meat consumption subsidised by cheap nitrogen fertilisers. This is questionable in sustainability terms.

JE: We don't need meat – it's just not necessary for human health. There is a growing trend to feed high quality protein from grain and pulses to livestock. But for the 900 million people around the world who are hungry, meat is simply unaffordable: access to grain is the problem.

What's the most sustainable way to produce protein?

SF: Waste food, particularly in the UK, should be fed to livestock. There's enough to feed all the cows we'd need for our milk supply. Any land not suitable for vegetables or grains should be used for animals. It's arguable that this land could be better used for biomass or forestry, but ruminants return nutrients to the land.

JE: Vegetarian sources of protein, like grains, pulses and nuts, have a much smaller carbon footprint than meat products – by about a factor of three. Pulses have huge agricultural benefits in that they fix nitrogen, like a fertiliser. Alternatives to soy, including the humble pea, are already playing a part in producing high protein, low fat food here in the UK.

What about dairy produce?

SF: I'd always advocate reducing the beef herd before dairy. Dairy is a more efficient way of delivering nutrients. There's a lot of grass in this country and it should be used for dairy production. Grass should be the primary feedstock, not grain. And organic practices need to move from niche to mainstream.

JE: Cows are fed high density feed to maximise milk production. Often it's soya, grown unsustainably. Retail prices for dairy produce are kept artificially low, so farmers depend on intensive high yields to make a living. Milk from goats and sheep can be managed more sustainably in upland settings.

How would you promote your preferred diet to an increasingly wealthy and culturally diverse population in the UK?

SF: Humanity on the whole is naturally greedy. But we know we're able to eat in a more measured fashion. There are plenty of celebrity chefs and farmers who are talking about this. I expect attitudes will shift as oil and food prices go up.

JE: Consumers need to be confronted with the facts at point of sale. Food labelling, where all the sustainability factors and nutritional data is presented in a simplified form, is a great idea. We're going to be looking for input across the board, especially from government and retailers.

Are subsidies a good thing?

SF: Not necessarily. The European Common Agricultural Programme (CAP) subsidies encourage wildlife-focused extensive agriculture which can lead to reduced yields. Lower yields can lead to the need for imports which means we're trashing other people's environments to save our own.

JE: Over the last 40 years, rising meat and dairy consumption has mirrored increasing subsidies to the livestock industry. We have deeply entrenched expectations that meat can be cheap. But these don't take into account the environmental costs. Organic meat production attempts to address this issue, but with limited market success.

Debates convened by Claire Wyatt.

Photo: EasyBuy4u / iStock



PRICE TAG

Food prices are volatile. But should we really strive to bring them down, asks **David Burrows**.

Do you know the price of a pack of sausages? Or a pint of milk? Probably not, and it's hardly surprising. In the past couple of years, the retail price of staple foods has changed more times than you've had hot dinners. The general trend, however, has been upwards.

The global food price index produced by the UN Food and Agriculture Organization reached 231 points in January 2011, the highest recorded value since the index began in 1990, and well above the previous peak of 213.5 in 2008.

If you haven't felt the difference at the check-out yet, it's because the cost of raw ingredients, like tea, coffee and cereals, takes time to filter through to the shops. In fact, supermarkets in the UK kicked off 2011 with a bargain bonanza worth £1 billion. At £2 for eight pints, milk was actually cheaper than bottled water. But costs as low as these are certainly too good to be true.

"The long-term trend is almost certain to be up, and quite seriously", warns Donald Hirsch, Head of Income Studies at Loughborough University. "If food prices were to increase at the same rate over the next decade as they have over the past four years, then a rise in the region of 75% is well within the realms of possibility."

So what's driving this trajectory? For one, the world simply has more mouths to feed. Today there is just 0.2 hectare of arable land per person in the world – down from 0.5 hectare half a century ago. There's also an increasing appetite for meat from India and China. China now imports vast quantities of soya beans – to fatten up its livestock as much as to feed its people.

"In 1995, China produced 14 million tonnes of soybeans, and consumed 14 million tonnes", says Lester Brown, President of the Earth Policy Institute. "In 2010 it again produced 14 million tonnes of soybeans; it consumed 70 million."

Fingers have also been pointed at hedge funds and banks for speculating on future food prices. For Julian Oram, Head of Policy for the World Development Movement, the price spikes of 2008 demonstrate the influence speculators had over the food market. He traces the surge in demand for agricultural futures – which saw an increase of 32% in 2007 – back to the failure of the

US sub-prime mortgage market the year before. Investors were looking for "somewhere else to park their cash".

Experts are now concerned by how well speculators are playing the market. Any shortage, due to a drought for wheat, for example, or a virus in rice, can trigger interest from commodity traders and further spikes. And why wouldn't it?

"The price of wheat has risen 87% in the last 12 months, and that's a great return in anyone's books," says Dave Norris, an independent grain market specialist. He suggests this 'financialisation' of the market accounts for "the top 20%" of rises in big commodities like wheat, corn or soybeans.

But rival demands for land are also having an impact. The explosion of biofuels, driven by national policies and the rising price of oil, has seen land turned over to energy crops.

"The US grows around 340 million tonnes of corn", says Norris, "a third of which now goes into the ethanol industry to light their streets or power their cars, rather than to feed people or animals."

And the productivity of agricultural land is, as ever, at the mercy of the weather. In the UK, a dry summer in 2010 created a shortage of feed. A harsh winter followed, forcing farmers to keep livestock housed and therefore buy in more feed, again driving up the cost.

"The winter affected us badly", says Hans Porksen, who runs Gallowhill Farm in Northumberland. "We couldn't get the sheep out to graze and so they were eating us out of house and home. I normally pay £100 a tonne for hay, but I had some delivered recently and it cost me £240 a tonne."

Phil Bicknell, Senior Economic Advisor for the National Farmers Union (NFU), says many farmers are finding it difficult to account for such hikes at the farm



Photos: Brian Jackson / iStock; calvia / iStock

gate, with retailers locked into competition for low prices in-store.

So how can we strike the balance between fair prices for farmers on the one hand, and affordability on the other? Bicknell advocates "more forward-looking contracts, or even 'cost plus' contracts which would account for this kind of volatility". Some retailers are finding long-term advantages in this sort of approach. Marks and Spencer was the first UK retailer to introduce a milk payment scheme that takes into account the costs of production and links the price paid to its farmers to the shelf price. Tracking these costs, it has found, encourages increased efficiency among producers.

Governments have a part to play, too. Nicholas Sarkozy has made greater global food price stability a key focus for France's presidency of the G-20. He is pushing to establish a central clearing house that would register global agricultural transactions and impose position limits

on investors, following the American model. There is also talk of international buffer stocks for grain.

Of course, the future of supply will depend on how we value its production now.

"At the moment, the true cost of a farmer's produce isn't reflected in the price people pay for their food", says Ian Price, food and farming expert at Triodos Bank. "I'm 56 years old. When I was young, my mum would buy a chicken from the butcher and we'd have three meals out of that. We'd spend 35% of our income on food. Now it's only 20%. We've driven down the cost of food, which allows people to do other things with their money. But we're not paying the true price in terms of water use, mineral depreciation, and so on."

And on this point, farmers and bankers agree. "People must be prepared to pay for their food," says Porksen. "I'm not saying it has to be as much as 40 years ago, but it has to be more expensive than it is now."

Teach a man to milk...

As food security continues to climb up the global political agenda, countries may start to harness their farmers' expertise as a very tradeable asset.

Developing economies expect their populations to grow exponentially over the next few decades. Yet for many of these countries subsistence-style agriculture is still the norm. So, technical expertise on more efficient methods of food production could soon be at a premium.

New Zealand dairy co-op Fonterra certainly thinks so. It is currently investigating a pilot farm in India to test out the effectiveness of its large-scale efficient milking parlours in one of the world's fastest growing dairy markets. China is also interested in tapping into the technical expertise of New Zealand farmers to feed its many mouths. And only last month a delegation of US and Brazilian bigwigs set out their stall for biotech and GM crops in the UK.

Could international trade see a shift away from commodities towards agricultural expertise? – *Will Frazer*



Big, white and shiny

Could the traditional image of a livestock farm with silage clamps, slurry lagoons and muck spreaders be up for a whitewash?

H₂O Farm's hydroponic forage system glistens with iPhone chic. Slick, compact and cleverly designed to meet a definite need, it claims to grow sprouting forage barley from seed-to-feed in just seven days, in stacked trays of nutrient rich water.

This new product entered the fray of agricultural shows at the end of spring 2010, when the food price crisis was no more than a whisper on the wind. By the end of the summer, over 500 farmers had expressed an interest in it.

It's an unlikely technology for those used to rearing their stock on grass, but with a succession of

dry springs, cold winters and more extreme weather likely as a result of climate change, farmers may find hydroponically home-grown fodder a wallet-friendly solution. – *Will Frazer*



Photos: H2O Farm Ltd; foiafing / iStock

Thirsty work

As the availability of water continues to fall, **David Burrows** reports on a rising trend for collaboration among growers and food companies to produce more crop per drop.

Imagine a world without oil, and a spectrum of renewables springs to mind. However dependent we are on it, oil is – both theoretically and practically – replaceable.

Water, on the other hand, is not. As Nestlé Chairman Peter Brabeck-Letmathe warned in 2008, “Under present conditions, and with the way water is being managed, we will run out of water long before we run out of fuel”.

Unlike oil, demand already outstrips supply. According to a McKinsey report on water scarcity in 2009, more than a third of the world’s population will live in water-stressed areas by 2030. “We expect water to grow from being a marginal issue to one that is central to all parts of the economy,” the report concluded.

Safe to say, it already is. All industries are reliant on water, but arguably none more so than the food industry. Agriculture accounts for 70% of global water use, and farmers are the first victims of water problems in terms of quantity, quality and access, according to the International Federation of Agricultural Producers (IFAP).

The availability of water is already having an impact on food prices and supply. The droughts in Russia in 2010 provoked Vladimir Putin to impose an export ban on wheat – a move which sent wheat prices to a 23-month high. Elsewhere in the world, the problem has been not too little water, but too much. In India, heavy rainfall out of season had a damaging effect on many of the country’s key cash crops, such as cotton and tea. By September 2010, the tea harvest had fallen short by 20 million kilograms compared to the previous year. This put “quite a lot of pressure” on the market, according to Mark Lawson, Director of Tea Buying for Tata Global Beverages.

Food businesses are increasingly attentive to the impact of water on supply chains. “Companies are realising that water is a material and strategic issue *now*, and not one for 20 years’ time”, says Marcus Norton, who heads up the Carbon Disclosure Project’s work on water.

Among them is Unilever. In the annual City Food Lecture, CEO Paul Polman said that the company is becoming “concerned” about whether the regions that produce its tomatoes – including Greece, Spain and California – will have “adequate water in the coming decade to guarantee us the harvest that meets our business needs”.

Leading businesses are already working with their suppliers to find solutions. Unilever is turning to drip irrigation (a system in which water is dripped slowly through small holes in pipes run along the base of the

plants) to ensure its tomato supply.

“With our tomato growers in California, we’ve been able to double the yields by providing the right varieties and using drip irrigation,” says Jan Kees Vis, the company’s Sustainable Agriculture Director. Trials funded by Unilever with the Indian Government have also seen success: gherkin yields rose 84% while water use fell by 70%. Importantly, profit per kilo has also “more than doubled” for the gherkin farmers [see ‘Magic in a gherkin’, *Monsoons and Miracles*, p25].

PepsiCo, which buys oats for its Quaker brand, apples to make Copella juice and potatoes for Walkers crisps, is another case in point. “We know where the water-stressed areas are and we are targeting our efforts there,” says David Wilkinson, the company’s Director of Agriculture. PepsiCo is looking at more water-efficient crop varieties and, with the help of Cambridge University Farms, has created an irrigation management tool called ‘i-crop’ to help growers produce more, with less water. It’s applying the same principles back at the factory, trialling a technology to capture the water lost when potatoes are cooked, and to recycle it for use in cleaning, peeling and slicing [see GF79, p11].

Unlike carbon, where a tonne saved in one area is the same as a tonne saved in another, water issues and impacts are localised. But the drive for ‘more crop per drop’ is not limited to dry climates. Wet as it can be, parts of the UK are coming under increasing water stress.

Indeed, England’s climate isn’t as uniformly damp as is often supposed. The eastern half of the country receives less rain than many parts of Turkey, and the majority of crops in East Suffolk (potatoes, carrots, onions and parsnips) depend on irrigation. But 63% of local water resources have been assessed by the Environment Agency as either “over licensed” or “over abstracted”, which means the farmers are first to face restrictions in a drought. If no water were available for irrigation, the value of agriculture in the area could fall by over £30 million a year, according to a study by Cranfield University.

Andrew Thompson, a researcher in plant sciences at the University of Warwick, is working on a prototype network of field sensors that collect data on soil moisture at different depths. The data is transferred wirelessly to software which determines where, when and how much to irrigate. The system helps to avoid “a host of problems in potatoes” caused by an uneven water supply, explains Thompson, both improving yield and minimising water use.

Ways to cut water use are also ways to save money. Moving water around a farm isn’t cheap. Farmers may only be charged a few pence per cubic metre to abstract water (at a rate limited by their licence), but then pumping, pressurising and delivering to an irrigation system can add another 40-50p per cubic metre. Storing it can double that cost.

“When people say water is cheap for irrigated agriculture in the UK, they are up a gum tree”, says Jerry Knox, an expert in irrigation and water resources at Cranfield University. “For farmers, it’s a highly valuable commodity, so using it more efficiently is their primary objective.”

To complement tools for efficient water management, Thompson is working to reduce the water that plants lose through transpiration. The pores on a leaf open and close in order to take in carbon dioxide, but lose water as a result. Researchers have found that in tomatoes the pores are actually opening more than they need to in relation to the carbon dioxide they require. Using GM approaches, Thompson has managed to optimise the opening of the pores without a penalty in terms of growth. The result?

“You need about 50% less water,” he explains. “We can also do it with traditional breeding techniques, but the savings are about 20%.”

However impressive the technological innovations, the key to local water management is collaboration. Here again, Unilever is on the mark, working with suppliers, regional governments and researchers.

In parts of the world where farmers have faced water scarcity – from Peru to Nepal – growers have,

for some time, been running water abstraction groups, or WAGs. These groups not only allow them to work together to minimize and share water scarcity in a sustainable manner, but also to defend their existing rights and communicate with the regulators.

The UK’s water regulator, the Environment Agency, is encouraging the concept of WAGs to help other catchment areas make progress like this, but to date there are only six in operation.

Andrew Alston heads up the Broadland Agricultural WAG, which now has 180 members across Norfolk with abstraction licences for 13 million cubic metres of water. “We’ll fight for every last drop of that because the farmers need it,” says Alston, “but at the same time we are making huge progress in the way we manage what we have.”

Indeed, BAWAG has turned one of its catchment areas from a position of over-abstraction (where the amount of water being taken is unsustainable) to one of over-licensing (where the full license amounts are not being taken). How?

“We’ve put reservoirs in place to collect water during the winter and using open seed beds. A lot of the land is hilly, and the soil is gravelly, which means when we got a lot of rain it was just running off. Now the open seed beds allow more water to be taken on by the soil,” explains Alston.

The combination of efficiency savings and greater awareness of our dependence on this precious – and precarious – resource should prove carrot and stick enough for most farmers and food producers. Those lagging behind can expect a wake-up call as the price we pay for water creeps up to meet its true value.

**Smart irrigation:
just enough and
not a drop more**



Photo: lucasvalheiro / istock

The Future Farm

Energy farming

By 2020, the Government wants 15% of the UK's energy to come from renewable sources. As custodians of 70% of the UK's land, farmers will be an important part of the picture. Farmers install wind turbines and hydropower, put solar PV panels on their roofs and in their fields, and use anaerobic digestors to convert waste into energy.

Sussex champagne, sunflowers and bug burgers

The amount of land planted with vine to produce English wine has increased by nearly 50% in the last four years. Hotter, drier summers and warmer, wetter winters mean British farmers have the opportunity to grow new crop varieties and access new markets. New protein options are a possibility – bug burgers anyone?

Brown gold

It can take 150 years for 1cm of topsoil to form, but in the UK we are losing 2.2 million tonnes of topsoil each year, costing farmers £9m/year in lost production. Good soil structure and nutrient management are key to maximising productivity, reducing nitrous oxide emissions and locking up carbon.

It's 2030. Consumers expect more transparency about the food products they buy, rising temperatures create opportunities to grow new crop varieties, water stress is placing demands on production, and rising energy and input prices are driving innovation and new practices.

The power at your fingertips

Precision farming can lead to fertiliser savings of 15-20 tonnes/year. GPS is already revolutionising farming by improving accuracy of inputs and reducing unnecessary fuel use. By 2030, farmers could be using simple hand-held devices to respond to real time conditions in the field.

The food network

In 48 hours the Yeo Valley video was viewed 210,000 times on YouTube and received 1,000 comments. Some farmers in the US now sell their entire product range through Twitter. In this networked and instant access world, farmers have more of a public face, and interact directly with their customers. They answer questions via the social network, play host to visits from school children, or run care farming programmes.

Moo-ving up in the world

By 2030, the world could be consuming nearly twice as much meat as it did in the 1960s. The debate on how much meat our growing population eats will continue to rage, and solutions such as intensive housed systems are likely to be more common. What's certain is that farmers will be under increasing pressure to produce more meat at a lower environmental cost. Efficiency gains – through better feeding, liveweight gain and breeding – will be important.

Go with the flow

By 2050, river flows in winter may increase by 10-15% but decrease by as much as 80% in late summer. Farmers are preparing for flooding and water shortages by reducing waste water and investing in streamlined water harvesting systems, high-tech irrigation systems and winter storage reservoirs.

Branching out

Planting new woodland/trees can capture and store an additional 5-15 tonnes CO₂e/hectare/year. Woodlands provide a range of benefits for farmers: they reduce the risk of flooding and soil erosion, provide biomass for heating, a valuable habitat for wildlife and offer shade and shelter for livestock.

It's a bug's life

In the last 20 years, there has been a 50% decline in bee numbers in the UK. According to the Parliamentary Office for Science and Technology, losing these and other pollinators could cost UK agriculture up to £440m/year. Increasingly, the industry is learning to value biodiversity. Farmers are planting more hedgerows, using natural pest control, and increasing field margins and woodland.



Land power

Are farms the energy hot spots of the future?
Huw Spanner warms to the potential.

*Old MacDonald had a farm, ee-i-ee-i-o
And on that farm he had some...*

...PV panels? With a spark, spark here, an inverter there, here a spark, there a spark... and so on. It doesn't exactly fit our childhood image of farming life, but then again very little in modern agriculture does. And at a time when many smaller farmers – and rural communities – are struggling to survive, there are compelling reasons to tap the huge potential of Britain's 300,000-odd farms to generate power and heat, save carbon, and make money in the process.

"Unlike food, energy pays well, is a reliable source of income, and requires little maintenance", says Will Frazer of Farming Futures. "Those energy farmers that have been on the pay-roll for some time now will have one defining characteristic: the ability to re-invest in their business. Ask one of the 461 dairy farmers in England and Wales that had to shut up shop last year, and you'll find that was a luxury they could ill afford."

The feed-in tariffs (FITs) for England, Scotland and Wales introduced by the last government in April 2010 (index-linked and guaranteed for 20–25 years) have certainly galvanised interest. Last summer, a survey of British farmers conducted by the National Farm Research Unit found that 70% were thinking of investing in renewables. If anything, says Andrew Rigg of the Farm Energy Project, that figure is now higher still. The recent review may sap some of that enthusiasm, but now that the seed has been planted, the idea of turning land into energy seems to have taken root. And it wouldn't be for the first time.

Two hundred years ago there were maybe 10,000 windmills across Britain, and those days may be returning. The options for farmers today range from using micro-turbines to power a single remote building all the way up to playing host to a commercial wind farm – or even installing one themselves.

"Wind turbines are brilliant in that they take almost no land out of production and the feed-in tariffs are good", says Adam Twine, who set up Britain's first community-owned wind farm in Oxfordshire. "In terms of punch per pound invested, they are solidly out in front at the moment." The 2,400 people who put up the

£4.5 million needed to pay for his five 1.3MW turbines expect an annual return on investment of 12% for 25 years. In 2010, a report from the property consultancy Carter Jonas calculated that a single 330kW turbine could yield an annual ROI of over 18%.

Offering the neighbours a share in the profits can be a canny way to deal with nimbyism. In Powys, a consortium of farmers has won approval for a plan to install 29 turbines on their land. Their Llaithddu Windfarm will generate nearly 67MW – enough to power well over half the homes in the county, saving up to 150,000 tonnes of CO₂ a year – and they have agreed to pay some £330,000 a year into a fund to benefit the local community. The arithmetic even allows them to buy Enercon's E70 turbine, designed by Norman Foster to be as elegant as possible, as well as exceptionally quiet and reliable.

For farmland that is sun-blessed rather than wind-swept, PVs hold out most promise. Ranging from 29 to 31 pence per kWh, the tariffs are the most generous of all. For farmers with large, south-facing roofs, at least south of the Midlands, PVs are "a bit of a no-brainer", says Jonathan Scurlock, the NFU's chief adviser on renewable energy. They have no moving parts, need very little maintenance and can be put atop barns and grain stores, dairy parlours and poultry sheds (though ammonia emissions from the latter, the NFU helpfully points out, can corrode them). Alternatively, arrays of panels can be deployed unobtrusively along the edge of fields, where they could also help to protect water courses and wildlife. Much larger installations can fill whole fields without detracting from agricultural output if the land is also used to graze hens, geese or even sheep.

Farmers who buy their own PV system, rather than renting space to a commercial operator, can expect an annual return of 8–12% on their investment, depending how sunny is their neck of the woods. Andrew Ingram, who farms 300 hectares in the Chilterns, put 156 panels on his barn roof as soon as the FITs came in. Today, he uses about one-third of the electricity they generate and sells around 14,000 kWh a year to the grid. With his

Photos: maxphotography / istock

High power: tall turbines leave plenty of space for grazing and crops



capital costs written off against his taxable profits, his panels may well pay for themselves in a decade – and could conceivably last for a further 40 years.

On steeper terrain, farmers can look to harness the energy of local watercourses with micro-hydropower. A 50kW system that cost £315,000 to install might earn (after running costs) in the region of £42,000 a year – and as long as it was kept oiled and maintained, it could well run for 50 years.

Wherever the farm, one source of energy is likely to be in plentiful supply: organic waste. An anaerobic digestion (AD) plant can shift any smelly slurry from ruminants, or silage from crop waste, and turn it into biogas, for use on site or for sale. Almost as valuable a by-product is the ‘digestate’: a rich mix of nitrogen, phosphate and potassium. These nutrients can go straight back onto the land, and that’s no small advantage.

“With oil back at over \$100/barrel and firmly linked to the price of fertiliser, farmers need to think about how to maintain their real life blood, which is soil fertility”, says Frazer. “We can generate energy from farms in any number of ways, but there are limited ways to make soil. AD can do it at low cost, and through natural processes.”

In Germany, there are already about 4,500 farm-based AD plants in operation, but in Britain there are no more than 45. “One problem”, says Andrew Rigg, “is that an anaerobic digester is like a cow: it needs looking after, and it needs feeding!” In Germany, a great deal of maize is grown specifically as feedstock, but that’s not something the British Government wants to encourage. Which could explain why the FITs for AD (ranging from 9 to 11.5p/kWh) are, by general consent, disappointing – probably 5p too low to be much of an incentive.

That doesn’t rule out a future for AD. In Cheshire, tomato growers A Pearson & Sons have incorporated it into their ‘whole-farm’ approach to sustainability. They’ve had a digester designed to fit the volume of disposable waste – mostly leaves and damaged fruit – which they generate. Instead of a landfill tax bill, they have home-brewed fertiliser for the tomato plants. The CO₂ is blown into the glasshouses, where it ends up in both bigger and tastier tomatoes. The methane is burnt in a combined heat and power plant, to heat the glasshouses and power the packhouses. Any excess electricity goes to the local town. And the payback on both pieces of plant has been remarkably quick.

It’s also proved a pull for customers, says Business Development Director Philip Pearson: “It excites them. It’s hard to put a value on that, but put it this way: we mention it in every presentation we do.”

AD is also attracting attention in India. Biotech Ltd, based in Kerala, has been working on systems to use food waste to make energy and fertiliser. It offers various sizes of plant, from a small one that home owners can use in their back yard to make biogas for cooking and fertiliser for their garden, to larger ones for schools, hostels and other institutions. The company, winner of an Ashden Award for Sustainable Energy in 2007, has even installed plants next to food markets, using the market waste to light the public space at night.

A strong case for growing *certain* crops to produce energy is made by John Gilliland, the chair of Northern Ireland’s Rural Generation, who champions short-rotation coppice willows. A plantation of these fast-growing trees produces wood for burning in anything from domestic stoves to full-blown power stations. Harvested every three

years, a hectare can produce 30 or more tonnes of carbon-neutral fuel, which currently fetches £110/tonne.

Some farmers prefer *miscanthus*, or ‘elephant grass’, which can be harvested every year. However, the real beauty of willow, says Gilliland, is that it helps to make agriculture more broadly sustainable. A belt of trees also sequesters carbon, filters pollutants out of waste water or the runoff from fields, helps to prevent the spread of disease between neighbouring herds and, in between harvests, provides a habitat for birds, mammals and insects. This is especially important as climate change begins to drive species northwards.

But at its core, AD is a fantastic recycling process for organic waste. “Our current farming system has high levels of waste food”, says David Fulford, biogas expert and a visiting judge for the Ashden Awards. “Disposing of it through landfill or incineration is expensive, but on-farm AD means food waste can generate energy and give its fertiliser value back to the land. It creates a resource cycle that reduces farmers’ dependence on outside sources of energy and fertiliser, which are both rapidly rising in price.”

Which technologies Old MacDonald should invest in will depend on a number of factors; but whether he is a small farmer who needs to supplement his income with a reliable new revenue stream, or an agribusiness manager looking to maximise profits, the opportunities are clearly there for the taking.

Huw Spanner is a freelance editor and regular contributor to Green Futures.

Farmer viewpoint

Tim Downes runs an organic beef, dairy and arable farm in Shropshire. His customers include Waitrose, Morning Foods and OMSCo.

...on reducing fossil fuel dependence

We’re fairly self-sufficient, but we do still use too much fossil fuel in our arable work. We’re trying to reduce it. We recycle the heat from the milk cooling process to warm the water we use to wash down the dairy. We’re saving a huge amount of energy that way, but we’ve also fitted solar panels. In June and July 2010, our electricity bill was down by 70%.

...on taking pride in the land

We take a lot of pride in looking after our soils. We haven’t used nitrogen fertiliser for 12 years, which has saved a lot of money. We’ve been growing clover to fix nitrogen since 1984. Researchers from the Scottish Agricultural College came to run a trial, and showed us the benefits of adding it to the forage. It delivers an extra half a litre of milk per cow per day!

...on conservation

We’re in the process of laying 2.9km of hedgerow this year, keeping alive old skills, but we rely on public funding for that, through stewardship schemes. We’re also involved in campaigns for educational access to the countryside.

A walk on the wild side

Can high yields and wildlife co-exist? And if so, what's the secret?

Anthony Kleanthous investigates.

Look ahead to a warm Sunday in March 2040. You're off for a country ramble, but what will you spot? Skylarks, corn buntings, deer and toads? A bagful of wild salad leaves for dinner? And where will the path lead? Through patchwork fields of pasture, vegetables and grain – or vast expanses of arable interspersed with concentrated animal feeding sheds?

The expansion and intensification of food production has provided us with plenty of cheap meals, but it has also destroyed much of the natural resource base on which it previously depended. Artificial fertilisers have impoverished the natural fertility of soils and released prodigious quantities of greenhouse gases into the atmosphere. Pesticides and modern harvesting methods have deprived birds of their sustenance and allowed populations of resistant pests to flourish. Traditional crop varieties – often uniquely well adapted to local conditions – have fallen into disuse, or been lost altogether.

Healthy ecosystems are essential to our food security: birds and other natural predators keep pests at bay; bees pollinate around a third of all our food; microbes and earthworms fertilise and aerate our soils. Today, their bill of health is sobering: a 30% decline in global biodiversity in the last 40 years; the loss of around half of our farmland birds in just 20 years, and worrying declines in the populations of amphibians and bees. The UN reports that two-thirds of all ecosystem services, including food production and pollination, are in decline.

For an illustration of what happens when we lose one of these vital ecosystem services, pay a visit to Sichuan, China, where bees had been successfully pollinating fruit trees for 3,000 years – until a rapid expansion of pear orchards in the 1980s. China increased the use of chemical pesticides, devastating

the bee population. Now, thousands of villagers trawl through the trees with bottles of pollen, into which they dip brushes made of chicken feathers and cigarette filters, touching them to hundreds of thousands of blossoms. In many places, such a solution would be prohibitively expensive.

To avoid getting into such a predicament, public funding bodies are paying farmers to create and protect wild habitats on their marginal land. Cousins Brian and Patrick Barker use parts of their farm in Suffolk to restore populations of 'target' wildlife species, with support from Natural England's High Level Environmental Stewardship scheme.

"In one of our ponds, we had one of the UK's biggest populations of great crested newts," says Brian. "With the money, we restored other nearby ponds, and joined them all up with grass margins and hedges to give freedom of movement. Now, we have well established and growing newt populations in these other ponds." The Barkers' other target species is the grey partridge, whose population has declined by 87% in the last 20 years. They used to spot one or two pairs on their land every so often. "We put down new areas of grassland and wild flowers to protect them from predators, and provide a nesting habitat. Now, we see five or six pairs on most days, with good evidence of breeding."

Like most farmers, the Barkers care about the countryside and value its natural beauty; but money has been the real driver for their conservation efforts. "Our parents' generation was incentivised to make their fields bigger and increase production at all costs. Output is important for us, too, but unlike them, we benefit financially from integrating production with good wildlife management and natural resource protection. By converting some of our less productive land to conservation, we can make more money."

Photos: Mark Yates / Nature Picture Library



Freebee labour:
insect pollination is
essential to
agriculture – and
pricey to replace



But taking this model to scale is impractical: there's simply more money in crops than conservation. As Simon Henderson, an organic farmer in Northumberland, explains: "Set-aside schemes pay on the basis of income foregone; if you convert arable land to a bird habitat, you get paid for it. We've taken fields on a flood plain on which we used to grow carrots, and converted them to grass. But, because the scheme classes all cropland as arable, our compensation is worked out as if we had been growing grain, which commands a lower price than vegetables on the market."

So why does he do it? Partly, he says, because of a personal attachment to nature, but also because much of their land is classified as a Site of Special Scientific Interest (SSSI), which attracts higher levels of payment for crops. Even then, the only way Henderson can fully fund his conservation efforts is by having his food certified as organic by the Soil Association. "It's very restrictive", he says, "but there's no other way for consumers to know that you are farming sustainably, [and so] justify the higher prices".

Funding isn't just available from government: some companies are beginning to pay premiums for grain from farms which take conservation into account. Cereal brand Jordans, for instance, pays a premium to suppliers to plant 10% of their land according to the Conservation Grade, which rules out GM products and certain agrochemicals and pesticides, and promotes wildlife-friendly practices.

But this trend could be challenged over the next few decades as the demand for food rises, and diets in developing countries become more dependent on animal products. Some fear that there may simply not be enough space for farmers to produce all the food we

need and still leave room for wildlife conservation.

The current trajectory is for further intensification, and a sustainable version of it – more output with less impact – is being championed by many, including the UK Government, as the answer. The Foresight project commissioned a collection of case studies exploring sustainable intensification projects in Africa, and found a number of lessons to learn.

"The challenges facing Africa are substantial", says lead editor Professor Jules Pretty of the University of Essex. "Many believe that agriculture across the continent has somehow lagged behind the rest of the world." On the contrary, he argues, "these papers illustrate that Africa is at the forefront of a new, greener revolution."

The research, published in the *International Journal of Agricultural Sustainability*, looks at 40 farms from 20 countries, where sustainable intensification techniques – such as crop improvements, agroforestry, soil conservation, integrated pest management and aquaculture – are being put into practice. It claims that, on average, crop yields more than doubled, boosting the livelihoods of over 10 million farmers.

To some, this simply sounds too good to be true [see 'Intensive or extensive?', p10]. But with more mouths to feed, it may be a challenge we have no choice but to rise to. As environmental campaigner Tony Juniper puts it: "Establishing truly sustainable agricultural systems is perhaps the most important challenge facing humankind today."

Anthony Kleanthous is a writer and speaker on sustainable development, and Senior Policy Adviser at WWF-UK, where he works on sustainable food systems.

Photo: ale12 / iStock

Farmer viewpoint

Simon Henderson runs an organic arable and sheep farm with an educational visitor centre in Northumberland.

...on plain English

A lot of the things we're challenged with now are things that my grandfather would have been *au fait* with. But we've forgotten them, or our focus has shifted. 'Soil carbon' is organic matter. The new terminology can be off-putting, but it's really just good farming. We need to simplify the message.

...on education

In 2005 we converted one of the farm buildings to a visitor centre. We wanted to show schools and the public the links between food and the environment. Farmer groups come to see some of the more complex things we do, like reed beds. It's all free, but we do have a café.

...on flood management

Talked about floods soon became actual floods. So we reinstated the floodplain. Having a river running through the farm needs careful management, but we're allowing it to permeate through the water table so it's more useful for growing crops.

...on food prices

We [as a nation] can't go on subsidising the food and farming industry. At the end of the day the tax payer is paying the price and it's an inefficient way of moving money from the consumer to the producer. I'd like to see a policy which allows the food price to rise, in real terms, slowly over time.

Farmer viewpoint

Edward Thompson runs Pixley Berries, Herefordshire, a 'not from concentrate' juice manufacturer specialising in blackcurrants.

...on pests

The range of pesticides available to us is ever decreasing, so we've had to respond by improving our understanding of pests and predators. What we have to do here is stop killing everything. We have biodiversity in Herefordshire. We have old oaks, woodland and hedgerows...

...on the weather

Today we are operating blind. We changed all our machinery to cope with wetter winters, but we had to phase out three of the five varieties of blackcurrant we were growing to find more resilient ones. It's been a huge change over the last five years. But we've maintained quality, and are now involved in helping the industry rate new crop varieties.

...on the industry

The future will be driven by farmers, scientists and the market place, rather than by the pressure groups. The response to our challenges will have to be led by science. What we're seeing is a concentration of production and marketing towards those businesses that have their eyes open to change.

...on global markets

The market I work in is European, yet I consider myself local. I have to be awake to the fact that I operate in a global market. The UK is a small part of the global food and science picture and we don't always have access to information from abroad. Networking globally is a huge advantage. There's a lot we don't know.

Photo: AVTG / iStock



Making space for
the king of the forest

Future farmer

Will farming fall down the skills gap?

Claire Wyatt of Farming Futures reports from 2030.

We're always looking for the next big thing, and for people with the skills to create the new world we crave. This has never been truer in the agricultural world. Climate change, a growing global population, land and water shortages, peak oil and food security are all putting pressure on farmers to adapt and improve.

And now the Government has weighed in with visions of what the industry should achieve and look like by 2030. "Consumers are informed, can choose, and afford, healthy, sustainable food", says Defra's Food Strategy. "This demand is met by profitable, competitive, highly skilled and resilient farming, fishing and food businesses, supported by first class research and development."

But that's only 20 years away! It begs the question, how will the day-to-day lives of farmers have to change? What jobs will they be doing? What new kit will there be? And, most importantly, will they have the skills to function in this brave new world?

Farming Futures has come up with six possible new jobs or specialisms that could become a standard part of farming practice. First, we looked at trends across the entire food chain to try to see what farming may look and feel like in 20 years' time. New crops and technology, from precision farming to GM, will help shape that reality, along with the increased pressure to reduce carbon emissions, changing expectations of the consumer, and complex and fluctuating economic and trade systems.

We also surveyed agricultural students and young farmers to see if they felt prepared for the industry they will

inherit. Among the students, 65% said that their course covered climate change and its impacts on agriculture. They ranked feeding our growing population as the number one challenge facing the industry over the next 20 years, with the rising cost of fertilisers a close second.

Many of them felt that open minds, climate change knowledge and IT skills set them apart from the current generation of farmers, and perhaps stood them in better stead to deal with the challenges ahead. A majority of 68% had already considered that their future role might include using the next generation of social media to build better relations with the public [see box 'Web 3.0 Farm Host', p28]. Florie Bryant, a final-year student at the Royal Agricultural College, remarked:

"We really need to bridge the gap between consumers and farmers. The media has so much power to influence the public, and we need to show consumers that we aren't as bad as is sometimes made out. They can forget the fact that farming is not just a job, but a livelihood."

So here are some sketches of just what that livelihood might entail come 2030. The aim isn't to predict the future, but to set out some possibilities and kick off the debate about how we could get there, and whether we'd want to...

Claire Wyatt is the Creative Advisor for Forum for the Future. She co-manages Farming Futures and specialises in creative communication techniques. To complete the Future Farming Skills survey, go to: <http://www.surveygizmo.com/s3/488166/Future-Farming-Skills-2030>



Geoengineer

Alongside a thriving food production business, this farmer also specialises in carbon sequestration. One method is biochar production [see 'Burn the trees to save the world?', GF72, p26]. Crops absorb CO2 from the air as they grow, but eventually release it when they rot. So the farmer steps in, burning all the leftover material in a kiln at a carefully-controlled temperature, so that it's converted to charcoal. This effectively 'locks' most of the carbon in the charcoal, preventing it from escaping to the atmosphere. It doesn't just tackle climate change, either: biochar has been shown to double or triple yields when added to soil: it retains moisture, gives a friendly habitat for fungi, reduces acidity, and provides access to important nutrients, such as potassium and phosphorus. The system works best with

a 'low till' method: by keeping soil disturbance to a minimum, it ensures the carbon is locked away under vegetal matter.

Some farmers are already experimenting with biochar and other carbon sequestration methods, but not on the scale we could see in the future. The farmer-geoengineer also maintains the local woodland and plants trees, so helping sequester more carbon. Love of the land and improved yields are an incentive, but financial rewards are also on offer for carbon capture...

Skills required:

- use and maintenance of a pyrolysis kiln oven/ biorefinery for biochar
- forestry, with a focus on indigenous species and agro-forestry
- intercropping, cover cropping, composting



Energy farmer

Many farmers already have a few PV panels on their land, or an anaerobic digester, but by 2030 energy production and management could be a principal source of income for landowners. Cows graze beneath silently turning wind turbines, pigs chill out above geothermal heat pumps, and hens cluck away under the solar thermal system. The farm's the depot for

organic waste, the hub for the local smart grid, and even the pick-up point for swipe and go electric vehicles...

Skills required:

- ICT proficiency for smart grid management
- maintenance skills for AD
- some expertise in energy efficiency

Images: Grain Media



Web 3.0 farm host

Consumer demand for transparency on food provenance and animal welfare – coupled with the next generation of social media, intuitive apps and prolific online data – mean farms need to be much better at public relations. Shoppers scan barcodes for all the ins-and-outs of the supply chain. They see the herd that produced their milk or meat in real time, or the fields and greenhouses from which their vegetables spring. They're bursting with questions and expect to

have someone on hand to answer them. That's the job of the farm host: building better relations right down the supply chain.

Skills required:

- management of electronic tagging and tracking systems
- ICT and social networking skills
- storytelling, presentation and writing skills.



Insect farmer

The humble bug is farming's secret weapon. Climate change has brought new pests along, but traditional pesticides are out of fashion. The need to protect valuable crops has led to huge demand for natural predators. Farmers breed insects in large controlled environments, to be let loose on the land. They also keep precious pollinating bees, and even some larger bugs for tasty snacks. As FAO Consultant Professor Arnold van Huis argues, meat from

crickets and locusts is significantly less carbon-intensive to produce than a steak, and a great source of protein and vitamins... Anyone for a pack of honey-roasted beetles?

Skills required:

- expertise in entomology
- bee-keeping and insect-breeding skills
- pest management.



Pharmer

The success of Omega 3 enriched eggs and fluoride-enhanced water has led to 'pharming'. Genetically engineered plants are grown and harvested to produce the proteins we need for various medicines and vaccines, at a fraction of the cost of conventional manufacture. Scientists are already growing plants with genetic instructions to make drugs for the treatment of HIV, rabies and Hepatitis B, as well as crucial dietary supplements. By 2030,

some nutrients will be delivered directly by eating the plant or drinking the milk.

Skills required:

- pharmaceutical and medical training
- biotechnology expertise
- GM crop management.



Herd homeopathy

OMSCo Farmer Tim Downes first started using homeopathy on his farm 20 years ago. "It works hand-in-hand with other management techniques such as decent nutrition and cleanliness", he says. "We use Aconite for TB testing, and Belladonna to treat a hot hind quarter. We've seen a real improvement in herd health, and it's cut down our veterinary bills."

Animal psychologist

Everyone knows the tastiest cuts come from the happy sheep. As demand for premium meat soars, farmers strive to read the needs of their livestock. A holistic approach includes better designs for yards and pens, dietary plans based on the best nutritional advice, close links to the local vet, a more personal relationship with the livestock, and some traditional remedies – from massage to homeopathy to acupuncture!

Skills required:

- animal psychology and behaviour expertise
- nutritional knowledge and management.

Charlotte's web

Thanks to social media, rural isolation is no longer a given for farmers. Far from it, says **Madeleine Lewis**.

She grew up on a dairy farm, bought her first cow when she was seven, and her husband's a dairy nutritionist. So when Michele Payn-Knoper was stumped by her Holstein dairy calf not weaning, she did what any self-respecting 21st-century farmer would: she went onto Twitter to get some advice. Within 20 minutes she had six ideas. One of them (to put grain directly into the milk) solved the problem and, one year on, her calf has just been bred – a social media success story.

Michele is the founder of Agchat, a moderated Twitter discussion that takes place every Tuesday night. Since its creation in 2009, over 2,500 people from nine countries have attached the hashtag #agchat to their tweets, and joined in to discuss issues and share ideas around food and farming.

It's a long way from the perception that Twitter is "just about what people are having for lunch", and with use of the platform growing at over 1,000% a year, it doesn't seem to be going away. The majority of farmers (56%) are now using the internet according to the National Farm Research Unit's 2010 survey.

Phil Gorringe – aka 'FarmrPhil' on Twitter – runs a mixed farm in Herefordshire. It's the most sparsely populated county in England, with the fourth lowest population density. For people living and working there permanently, especially farmers working out in the fields most of the day, often alone, that can be isolating.

Phil believes social media is a great way to tackle that isolation. Once he's taken off his wellies and had his dinner, he settles down in front of the telly with his laptop to hand. He's got one eye on the Twitter conversations developing, and one eye on the TV. Evenings are a good time for him, with both his UK and US friends and followers online.

As he puts it: "Social media gives a mental advantage when farming isn't going so well. In the last few years we've been dealing with lower prices for our products, difficult weather conditions and bovine TB. It can be a lonely place. Through social media I can share my problems and realise that others out there have problems

too. It makes you feel better."

He's not the only one. Alabama dairy farmer Will Gilmer tweeted his day's work ("209 milked, three bred") and heard straight back from Ryan Bright in East Tennessee: "all 100 milked and two bred before breakfast". 'Farmerbright' then tweeted that his newly-repaired silo auger (an apparatus to shift grain) is still holding together, and got an offer of a new one for sale.

But farmers are not just reaching out to each other for support. Social media is also a powerful way of talking directly with consumers. For Phil and his wife Heather – aka 'Wiggled' – social media has also helped to get an important second income stream off the ground. Heather runs Wiggly Wigglers, a natural gardening mail order business and online information source for everything from composting to water management. Her active engagement with the grow-your-own community on Twitter has proved a great way to boost its sales.

Heather describes social media as "word of mouth on speed" and says it allows her rural business to compete with those with bigger advertising budgets or which have more footfall. She started with the 'Wiggly' podcasts and has built her Twitter following to over 3,000. Now she reaps the rewards. When she puts up a Wiggly offer on her Facebook page, she'll get 30-40 orders within an hour and a half, and 7% of her website visits are driven from Twitter. It's a very cost-effective form of advertising.

She's not alone. Phil Grooby, of Bishops Farm Partners, Lincolnshire, started using Twitter to show consumers what it takes to get peas from the field to the table. Grooby belongs to a pea vining group that harvests about 900 acres each year. He finds social media "a useful tool when it comes to setting the record straight and showing people how farmers care for the countryside". 'FarmrPhil' agrees. "Twitter is the perfect medium for farmers to engage in differential marketing in a world of commodities", he explained in a tweet to over 1,000 followers, adding in another that "SM [for 'social media'] encourages transparency ... increases consumer confidence and promotes choice".

Social media: "word of mouth on speed"



Offline, he confides: "We don't do horrendous things as farmers, but we've been brought up to be terrified of the outside world seeing in. It's been a pleasant surprise that when we tell our story via social media people aren't horrified by what we do – it's shown me that there's no need for secrecy."

'SM' also offers farmers the opportunity to engage directly with policy makers. "It gives us a level playing field that we've never had access to before," says Phil. "Recently a senior conservation spokesperson wrote on his blog that he didn't trust farmers to carry out the Campaign for the Farmed Environment (an industry initiative to improve biodiversity and resource protection on farms). I challenged him on it and he apologised and changed his blog."

On the other side of the fence, policy makers are finding social media a valuable shortcut to stakeholder engagement. Mark Avery, Conservation Director of the RSPB, tweets, uses Facebook, and has his own blog that senior people in industry and government read. As he puts it, "It's like having a five minute chat with the likes of Peter Kendall (President of the National Farmers Union), Peter Unwin (Acting Permanent Secretary, Defra) and Richard Benyon (Parliamentary Under-Secretary for Natural Environment and Fisheries) every day. I don't need *Farmers Weekly* or a national newspaper to speak to people. And I have conversations direct with farmers too – when I used the term 'intensive farming' on my blog several farmers wrote to me to challenge my use of it."

The media has been fast to pick up on the trend. Caroline Stocks is Deputy News Editor for *Farmers Weekly*, the biggest magazine in the industry. She recently travelled to several different continents on a Nuffield Farming Scholarship, to explore new media, journalism and farming. She found farmers everywhere had something in common: "Regardless of where farmers are in the world, they're all very similar and face similar issues and struggles – from retailer power and securing contracts, to managing water supplies, debating conventional, GM and organic systems and improving yields. And to achieve their goals they all

need clear and up-to-date information."

Social media has changed the way she approaches her journalism. "Many of the stories I write now come from links and contacts I have found on Twitter", she acknowledges. "It also means I now take more of an international approach to my news, writing as I know farmers from across the world are reading my articles. I've met farmers in India who don't have computers but use message boards via their mobiles."

So is social media just a fad? For Payn-Knoper, the answer is unequivocally 'no'. She says it has been a "cultural shift". That's why last year she founded the AgChat Foundation with other farmers passionate about social media. The non-profit aims to empower a connected community of 'agvocates', by training farmers to use social media. In August 2010, it organised Agvocacy 2.0, gathering 50 people from the agricultural industry to refine their SM skills and share experiences. They have plans for more of the same.

But Payn-Knoper also believes there is a challenge ahead: "The next big thing for social media and farming is a way for information to be more effectively managed through social hubs. Many people are just at the point of information overload."

At Farming Futures we started to use social media about a year ago to do just that, creating a hub for useful information, news and views about climate change and farming from people across the agricultural sector. We run a user-generated blog, reach out to communities on Twitter to do research and share ideas, and make use of other tools and platforms such as Audioboo and Slideshare to share our information in more accessible and interesting ways. Social media can't take the place of face-to-face communication, so we still run very popular on-farm workshops – but it's a great way of getting people along.

Madeleine Lewis is Creative Communications Manager at *Forum for the Future*. A former radio and online broadcast journalist and producer at the BBC, she co-manages *Farming Futures*.

Photo: Farning / iStock