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## *From soil to sale: the impact of food production*

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# FOOD AND THE BUILT ENVIRONMENT

There may not be a silver bullet to solve all the challenges facing our food system, says **EIKE SINDLINGER**, but localised food production could become a key stepping stone towards a circular economy

The evolution of civic societies and urban settlements has always been closely linked with the ability to produce and deliver food to their residents. In the face of peak oil, climate change, a growing global population and anticipated resource shortages, it is about time our society re-examined the relationship between food and the built environment.

## Issues

More than half of all people now live in cities and this trend towards urbanisation is set to continue (see Figure 1). However food is mostly produced in the countryside, where land is cheap and readily available in large quantities.

Yet cities and urban agglomerations seem to occur in the exact same location where our most valuable cropland lies, leading to competition for space between farming and urban growth. This is hardly surprising if you look at the development of cities and their relationship to food. As Carolyn Steel describes in her book *Hungry City*, in pre-modern times the size of any town was limited by the amount of food it could gather either from its surroundings or through shipments from further afield (Steel, 2008, p70). Modern transportation, packaging and refrigeration changed this relationship dramatically, transgressing this physical connection. Today, about 40% of all food we eat in the UK is imported – this is up from 29% in 1988 (Defra, 2008).

Of course, not only transportation restraints but also yield per hectare played a key role in limiting both urban and global population growth. Historically, significant advances in agricultural technology allowing for a substantial increase in yields were sooner or later outpaced by population growth, resulting in famine and starvation.

Because the availability of land is ultimately finite, fixing nutrients, particularly nitrogen, in the soil through crop rotation became a major constraint for increasing yields. The invention of artificial fertiliser and the ability to fix nitrogen from the atmosphere through the Haber-Bosch process combined with new high-yield crops, the development of pesticides and the mechanisation of agriculture and

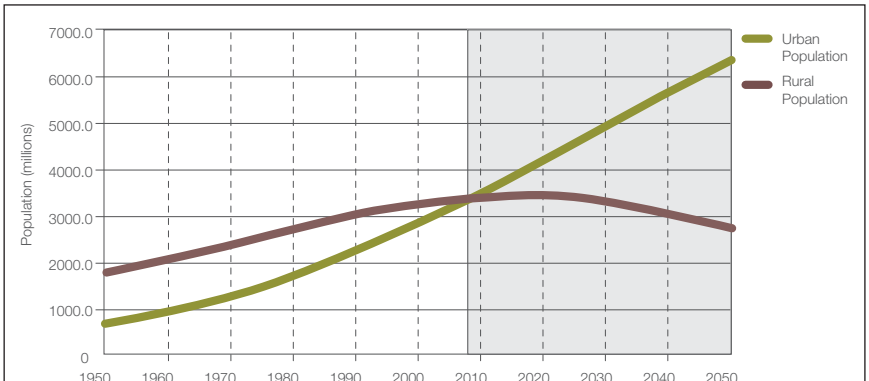


**Figure 1: Global urban and rural populations 1950-2050** (UN, 2007)

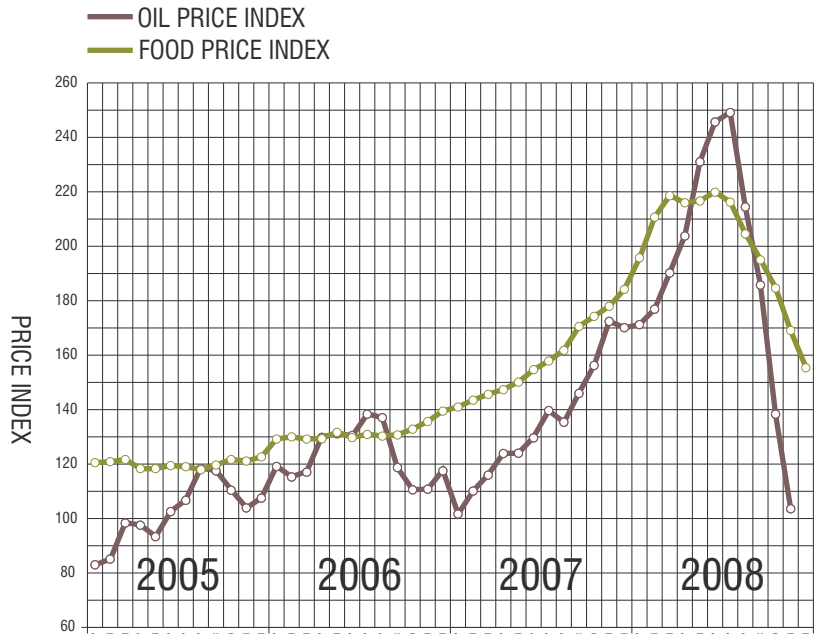


**Figure 2: Food Price Index vs. Oil Price Index**
© Arup (FAO and Index Mundi, 2010)

food production allowed us to produce more than we can eat. This so called 'Green Revolution' enabled farmers to quadruple their yields within 50 years. In the past, yields had only ever doubled in about twice the time (see also Roberts, 2008).

Thus we went through a period of overproduction in the 1980s, where famine problems were more a question of inadequate distribution than a global lack of food. In return, though, agriculture became highly reliant on external inputs, a lot of which come from non-renewable sources. The report *An inconvenient truth about food*, commissioned by the Soil Association (2008) estimates that 95% of food in the UK is oil dependent in the form of fertilisers, pesticides, transportation and energy inputs. Thus it is no surprise that the development of global food prices seems to mirror the cost of oil (see Figure 2). Even putting carbon emissions aside, we need only think of peak oil to understand the significance of this relationship and what it might mean for the future of our food supply.

Nitrogen, one of the three key nutrients for plants is a significant contributor to climate change, as one of its derivatives $NO_2$ (Nitrous oxide) is 310 times more damaging than $CO_2$ (Soil Association, 2008), and its atmospheric supply is effectively infinite (see also Roberts, 2008). Phosphate, another key nutrient, is mainly obtained from a mined mineral, supplies of which are predicted to run out within 30 to 50 years (see Figure 3).

Agriculture is the largest consumer of potable water, where irrigation is responsible for 70% of the world's water withdrawals, and 93% of water depletion, overall water withdrawals have left 24% of the world's river basin area in severe water stress (Luebkeman, 2009). Not only can this have a huge impact on our environment – as we can observe in the case of the Aral Sea – but once the water supply of any region is used up, food production could decline rapidly, along with the effects of climate change, bringing rising temperatures and desertification.

The Green Revolution produced more food more cheaply than ever before, enabling unprecedented population growth. Global population has more than doubled since the 1960s and is expected to rise to an estimated 9.15 billion by 2050 (United Nations Populations Division, 2010), putting further strain on the resources propping up our food supply system.

Yet demand is increasing both for food and non-food related agricultural outputs, such as fuel and materials. The average global income is forecast to grow and with increasing prosperity, people's eating habits change from a vegetarian-based diet to one involving larger amounts of meat and products, as happened in China (BBC News, 2008). A rising meat and dairy consumption fuels an

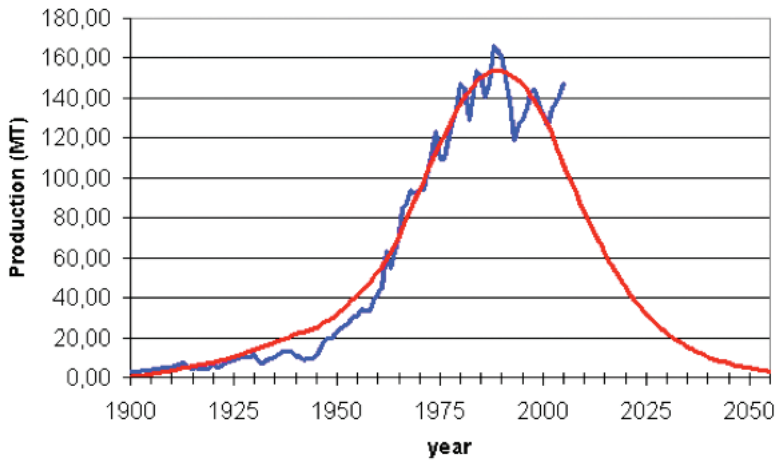


**Figure 3: World Rock Phosphate Production** (Déry and Anderson, 2007. See also Soil Association, 2008, p9.)

increase in livestock, competing with humans for agricultural outputs. Animal protein requires 2-3.5 the land take and 5-10 times the amount of water (FAO, 1997) compared to producing the same nutritional value with vegetable protein. Livestock alone make a substantial contribution to greenhouse gas emissions (FAO, 2006).

Depending on your lifestyle, where you live, what you eat and how you calculate it, your food consumption in general has a significant impact on your carbon footprint. A study by the Australian Conservation Foundation suggests that 28.3% of the average person's carbon footprint in Australia is related to food (ACF, 2007). This represents almost twice the emissions caused by personal electricity/energy use, more than twice the amount the construction industry emits and about three times the emissions linked to personal transport. The same study looked at the eco footprint of food, and due to the amount of embodied water, food consumption accounted for almost 50% of the 6.4 global ha per capita needed to sustain their current lifestyle.

Our food production and supply system has evolved to become highly dependent on external, non-renewable inputs. It is therefore vulnerable to the impact of peak oil, peak phosphate, water depletion and climate change. It also shows signs of struggling to cope with the challenges a rising global population poses, while meeting the demands for non-food related products and agricultural outputs. At the same time food production is both a significant contributor to the causes of climate change as well as a key victim of its consequences.

Describing the issues affecting our food system gives us an indication of what we need to do in order to tackle the problems ahead.

## Challenges and synergies

A key challenge will be to replace non-renewable external inputs with sustainably resourced inputs and return food production to its natural cyclical state. In that context we have to look at the spatial disconnection between food production and consumption. Nutrients and water, the base ingredients that make up our food, are displaced through the expense of energy (oil) from one part of the world to another without ever finding their way back.

Balancing the pressure for development with the necessity to provide food and fostering a positive, dynamic relationship between food and the built environment can help us to restore these cycles. All we need to do is to think of food production as an integral part of the urban infrastructure, in the same way we consider roads, water, drainage and power supply. How to feed the residents should not be an afterthought, but an integral part of any masterplan. This would allow us to address a whole range of issues.

For instance, instead of being a problem to deal with, organic waste can be turned into compost and methane, providing nutrients for plants and fuel for heat, electricity or even cars. $CO_2$, the by-product of turning gas into heat and/or electricity, could be captured and used to stimulate plant growth in greenhouses. Black and grey water from households could be treated and used for irrigation. After all, urban organic waste (including human waste) is rich in phosphate.

Current government thinking is leaning towards avoiding waste with composting high on the agenda in a drive to reduce landfill (Cook, 2009). Many local authorities up and down the country have started to collect kitchen waste, and are promoting home composting and wormeries in back yards. But our thinking should not stop at turning organic waste into compost, but envisaging an integrated and fully cyclical process whereby all outputs of this process are ploughed back into the food cycle.

There are also other, less tangible synergies when food is produced nearby. Locally grown and marketed food can reach the consumer quicker and fresher. It would provide more nutrients than conventionally produced and transported foods, thus contributing to health and wellbeing. It would also save on energy used for transport, storage and refrigeration.

Food is a great integrator. It can bring people from different backgrounds and cultures together. Innovative landscaping could make healthy, fresh and seasonal produce visible and thus start influencing our food consumption habits and changing our diet. The latter is not without importance given both a growing obesity problem in many developed nations and the considerable contribution our food production makes to climate change. Community gardens and allotments are particularly suitable in helping people to understand the seasonality of food and provide poorer people with access to high quality food. But they also provide amenity and can help to spread biodiversity.

The objective of a new urban-rural relationship should be to create a localised new form of urban and peri-urban agriculture which creates social, economic and environmental values through a systems approach to energy, waste, water and food production (see Figure 4). The use of cutting edge technologies can be used to promote localised urban farming. This can unlock 'new' growing spaces and thus increase food production which could help in reducing dependency on importing our food.

## Examples

The objectives may be clear, but are there any precedents? Combining waste treatment with food growing is not a new idea. In 1869, the first ever municipal sewage treatment works outside of Paris allowed local farmers to cultivate the land and use the sewage water for irrigation to quell local opposition (Steel, 2008 p277). The sewage farm was born, with very high yields, and the area became the key

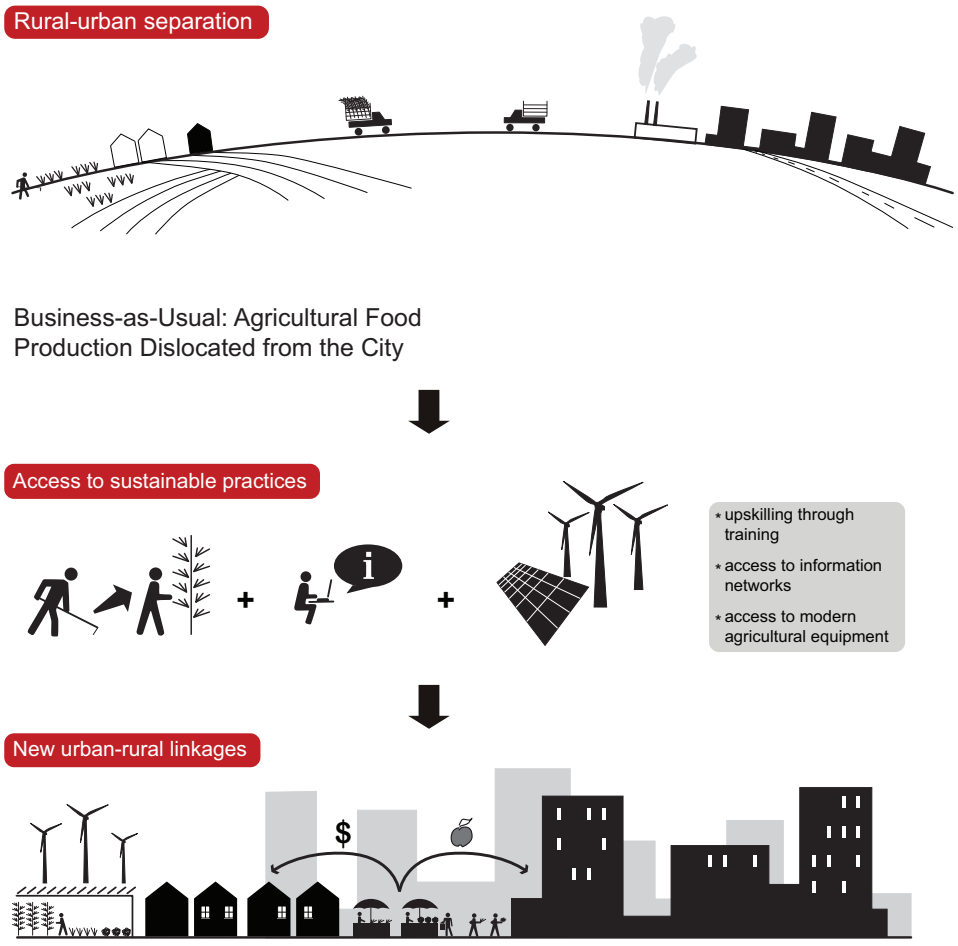


**Figure 4: Integrating food production and urban development for Whanzhuang**
© Arup

horticultural supplier of Paris. This system was then replicated in many cities and towns across Europe. However, at the time road drainage was mixed with industrial and domestic waste water, thus increasingly contaminating the sewage water with heavy metals; therefore today these sewage farms are no longer in use.

A contemporary version of a waste-to-nutrients cycle can be found in the many biogas facilities installed in Germany and Switzerland. The aptly named specialist company Kompogas is only one of many that have been installing facilities producing both fertiliser and fuel for many years (Kompogas, 2007).

As for the principle of growing food in cities, Britain had its own experience of urban farming during the 1940s in the form of the 'Dig for Victory' campaign. At the time, a lot of the food consumed in the UK was imported from Canada. This made the country's food supply vulnerable to German attacks. To avoid being starved by a siege, becoming self sufficient in food quickly became an integral part of the defence strategy. Thus almost every available bit of green space in London and across the country was dug up and turned into food producing allotments.

In more recent years, another crisis caused a similar radical shift towards urban food growing. With the collapse of the Soviet Union in the 1990s, Cuba lost 80% of its trade and with it access to chemical fertiliser and transport fuel. Calorie intake per head almost halved compared to 1980s levels. Thus the country was forced to rethink its oil dependent agricultural strategy in order to feed its population. The *organopónico* was born, a kind of urban farm producing food organically for the local community. This example of urban food production has been well published (Birch, 2009).

Thus maybe it is no wonder that in recent years urban food growing has become a popular topic in the UK. Initiatives like London's Capital Growth project or the Middlesbrough Urban Farming Project 2007 promote small scale urban food production in cities. Restaurants and supermarkets are also discovering the benefits and the marketing value of producing some of their herbs and vegetables on their own premises.

At local government level, issues around food can become the catalyst for unusual alliances. The Good Food for Camden programme is a remarkable example of two government agencies (the Camden PCT and Camden Council) working together with businesses and the community to help local people to buy, eat and dispose of food in a way that helps both their health and the environment. Encouraging localised food production and distribution is part of this initiative.

On a larger scale, there are more and more masterplanning projects coming forward, which seek the integration between food production and urban development. Arup is pioneering the concept of food production as part of the urban infrastructure on several projects.

Arup's masterplan for The Co-operative Eco-town in Leicestershire has an integrated food and farming strategy with the objective to supply fresh, local, healthy food to the town and involve the community in food production

while retaining a commercially viable farming enterprise, producing eggs, milk, and fresh, seasonal vegetables for residents, visitors and The Co-operative retail outlets. The concept considered virtuous cycles of water, food, waste and energy on a whole town basis. It includes community gardens and orchards at the heart of the development, allowing all residents to be involved with food production while providing the opportunity for formal volunteering and thus the creation of social capital.

Arup's concept masterplan for Whanzhuang eco-city in China focused on the integration of existing agricultural land use as the starting point for developing a new town for 330,000 people. The proposal suggested reconnecting food production and consumption and changing current unsustainable farming practices which left local aquifers highly depleted to more resource efficient and more labour intensive farming methods. Initial calculations suggested that the proposed polycultural farms could cater for up to 99% of the fruit and vegetable requirements of the new community on the remaining farmland. Compared with business as usual, this approach could mean a fourfold increase in food production per ha and a potential twofold increase in income for farmers. At the same time it could provide twice the number of jobs, thus keeping employment at current levels despite a significant reduction in farmed land. Despite relative yield increases, agricultural water usage was projected to reduce by 75% compared to business as usual. Furthermore, the physical integration of new development, existing farmland and orchards creates an appealing place for new and existing residents alike.

But perhaps we should not only think about *how and where* we produce food, but also consider *what* we might eat in future. Both hydroponically and earth grown sprouts of crops like broccoli, alfalfa or sunflower are considered health foods, rich in nutrients, minerals and vitamins. Their fast growing cycle and the fact that sprouts need hardly any other inputs than light, water and air make them a very interesting urban cash crop.

## Conclusion

There is clearly not going to be a silver bullet to solve all the complex challenges facing our food system. But as the examples have shown, localised food production is clearly a

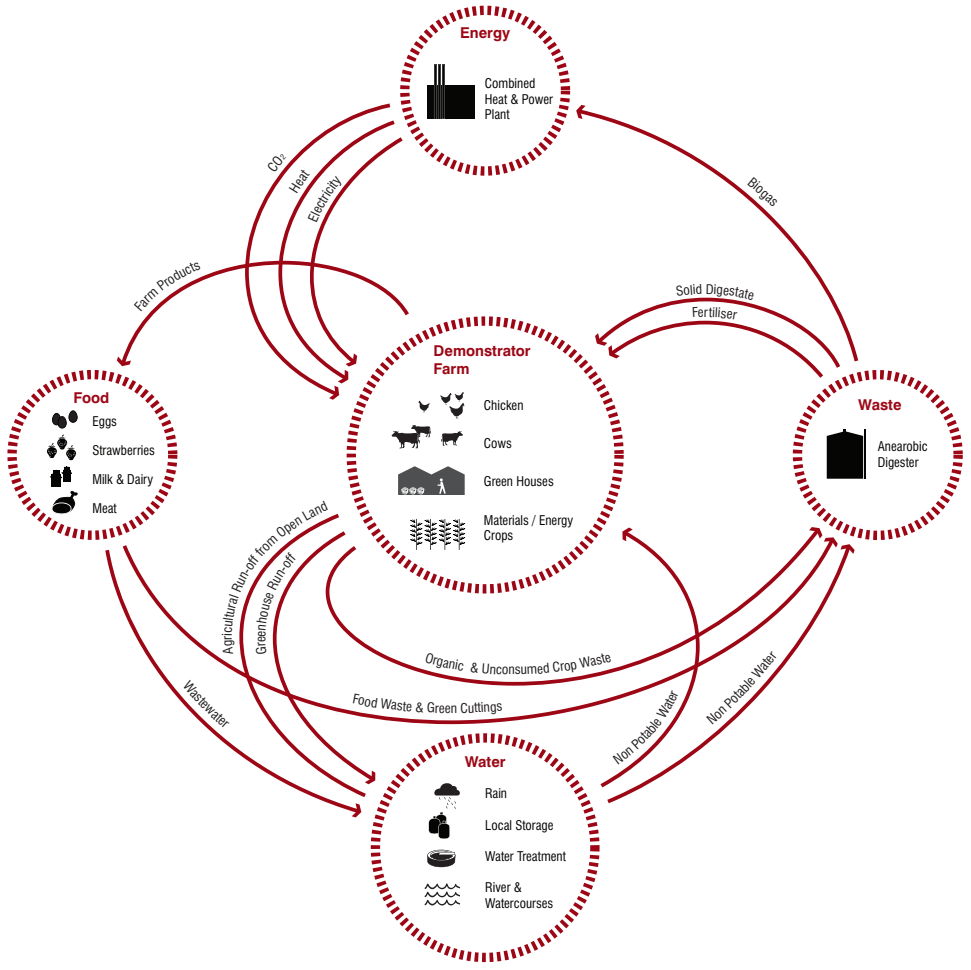


**Figure 5: Resource Flows for the Eco-town for Leicestershire (The Co-operatives Estates, 2008)**

**Figure 6: Visualisation of Whanzhunang**

missing link in both urban and rural ecology and it could become a key stepping stone towards a circular economy. When modelling resource flows, it becomes apparent that reconnecting food production and consumption can play a significant role in closing water and nutrient cycles, levelling the carbon balance while generating social and economic benefits. So perhaps it is time that professionals involved in built environment start thinking about food in a very different way than we have done in the past.

◆ Eike Sindlinger works as senior architect and urban designer for Arup.

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# THE FUTURE OF FARMING

Farmers in the future will have to produce more food with less energy, water and space. But greater efficiency will save them money, argues **MADELEINE LEWIS,** and better productivity and renewable energy generation will turn a profit

What will our British farms look like in 2020, 2030, and even 2050? Demands from 'carbon savvy' consumers, rising energy and input costs, the push for renewable energy generation, and the twin pressures of climate change and food security mean that farming is undergoing a revolution.

## It's not just about carbon…

Climate change as a political challenge came to the agricultural sector relatively late. While most other sectors of the economy have had greenhouse gas (GHG) emissions reduction targets for some time, it was not until the publication of the Low Carbon Transition Plan in the summer of 2009 that the agricultural sector began focusing on their emissions. The UK government plan has tasked farmers and land managers to reduce their emissions by 3 million tonnes of $CO_2$ equivalent, roughly 11%, by 2020.

Agriculture is different from other sectors of the economy in that carbon dioxide is not the main GHG emitted. Of the 7% of GHG emissions from agriculture, 3.5% are nitrous oxide, and 2.8% are methane. Nitrous oxide is emitted mostly from microbial activity in soils and from fertiliser usage; methane is emitted mostly from the digestive systems of ruminant livestock. Nitrous oxide is 275 times more damaging to the atmosphere than carbon dioxide and methane is 62 times more damaging within a time horizon of 20 years (IPCC, 2001).

The agricultural industry is broad and diverse, but principally the livestock and large-scale arable farming sectors are where the larger GHG reductions will be realised. The livestock sector's statutory levy bodies Eblex (English Beef and Lamb Executive) and Dairy Co are quite clear about how to reduce emissions per kilogram of meat or litre of milk produced: increase production or liveweight gain and optimise health, fertility, and feeding.

The drive towards efficiency is also the message for the arable sector. Although the nitrogen cycle and its interaction with other elements in the system is highly complex, the key to reducing nitrous oxide emissions is efficient nutrient management, by applying the right amount of fertiliser (organic or manufactured) to soils at the optimal time for take-up by the crop.

But as with anything in the climate change debate, the reality of things is even more complex than it at first appears. Take for example the meat and dairy debate. Much of the countryside in the UK is unfit for any food production other than livestock grazing. Not only do these livestock convert land into valuable protein, but they also maintain the uplands landscape that we hold dear. It is not just a question of aesthetics – livestock and land perform very important ecosystem services, ensuring biodiversity, clean water supplies, and protecting carbon sequestered in the soil.

Even though the major emission reductions can be made in the livestock and arable sectors, we should not forget the rest. Poultry farmers will need to be highly energy efficient in their sheds and packing plants, and many farmers may wish to invest in renewable energy generation such as wind or biomass. After all, to reach the 80% cut that we are now legally obliged to make in the UK, everyone will play a part, and we need to do so without simply cutting UK production and exporting the problem – and the emissions – overseas.

## Warmer climates

Reducing GHGs is only part of the picture. Some climate change is inevitable – and as an environmental challenge it hits those who work the land first. In the 2009 Farming Futures survey, 50% of farmers and land managers said that climate change was having an impact on their land now, and 63% said they expected it to have an effect in the next ten years.

Longer growing seasons, hotter and drier summers, wetter and milder winters, coastal erosion, more frequent extreme weather events are all to be expected in the next few decades according to the UK Climate Impacts Programme's 2009 report (UKCP, 2009).

So what does this mean for farmers and land managers? Higher temperatures and lower rainfall is a risk, particularly for irrigated agriculture, which is responsible for producing a third of the UK's potatoes and a quarter of all vegetables. The Vale of Evesham in Worcestershire is a hub of the UK's horticultural industry and produces a variety of crops from beans to potatoes to fruit. But these crops are thirsty, and a 2007 Cranfield report predicted that the demand for water in this area will increase by around 20% by the 2020s and as much as 50% by 2050. Growers are going to have to do more with less: 'more crop per drop'.

Longer growing seasons give certain pests with rapid breeding cycles an extra one or two generations to do more damage, and others will be able to move outside of the glasshouses where they bed down over winter, or spread

further north. Potato late blight is one example. Potatoes are the fourth biggest crop in the UK, and late blight is one of the most important diseases growers contend with. Climate change could make that a tougher battle.

But it is not all doom and gloom. The UK could benefit from rising temperatures, longer growing seasons and changes in the growing area of crops. It is therefore possible that more Mediterranean crops such as olives, sugar snap peas, melons and grapes could become successful. For example, English wine is now being produced as far north as Yorkshire.

## Powering the future

A renewable and secure energy supply is also top of the political agenda. The UK now has a target of producing 15% of all our energy from renewables by 2020 and, in practice, that is likely to mean 25-35% of our electricity. With 70% of the UK's land in the agricultural sector, farmers and land managers are going to be part of the solution.

The Government announcement of feed-in tariffs for small-scale renewable energy generation last month is building a strong business case for investment for those with the right resources. These tariffs are designed to stimulate renewable energy flowing into the National Grid, and the Renewable Heat Incentive due next year is likely to lead to more rapid development in this area.

The big power stations are getting in on the act too. Drax power station is the largest coal-fired plant in the world and currently produces 7% of the UK's electricity (Pearce, 2010). It has three new 300 MW biomass boilers in development on the East Coast, due to come on stream between now and 2020. If they are all in place and firing come that date, Drax will be responsible for at least 15% of the UK's total renewable power – and it wants as much of its biomass to come from UK farmers as possible.

At Farming Futures we have seen a massive upsurge of interest in renewable energy generation over the last year. Our on-farm events focusing on this area have been consistently oversubscribed, and our factsheets on the subjects have been flying off the website and out of the door. Energy generation is fast becoming an exciting diversification opportunity for farmers and land managers.

## Are farmers ready for these changes?

Change is required. Farmers are going to have to produce more food with less energy, water and space, while adapting to a changing climate, generating renewable energy, and responding to shifting consumer demands. After all,

although we may have to change some of our eating habits, and certainly the amount of food that is wasted, food is not a luxury and we are going to need more of it.

So the pressure will be on for agriculture in this new 'low-carbon' world. Science and research will have a role in delivering pest and drought-resistant crop varieties, we need to work harder to protect our soils, and GM will no doubt be back for debate. But the good news is that many of the changes needed at farm level are win-win. Greater efficiency will save money, and better productivity and renewable energy generation will turn a profit.

Farmers have been innovating for thousands of years: together with land managers they are the original entrepreneurs. With the right tools and information (and appropriate incentives) they may be able to keep up with the rate of change required for a sustainable future.

That is where Forum for the Future's project, Farming Futures, comes in. A collaboration between the industry (the National Farmer's Union, the Agricultural Industries Confederation, the Agricultural and Horticultural Research Forum, and the Country Land and Business Association), Forum for the Future, and Defra, the innovative communications project aims to inform and inspire farmers and land managers so that they can respond to the challenges and opportunities of climate change.

Along with other sectors in the economy, over the next 40 years farming will undergo great changes. Farmers are going to be central to the health and success of our society as we shift to a 'low carbon' world. Their detailed knowledge of their land and their entrepreneurial spirit will be key to getting this right.

## Case Study: Broadland Agricultural Water Abstractors Group

As climate change bites over the next few decades, water resources will become an increasingly big issue for farmers and land managers in the UK. Hotter, drier summers will place greater pressure on supplies at the same time as the industry is being tasked with producing more food for a growing population.

In eastern England, a group of farmers are working together to tackle this issue head on. Set up in 1997, members of the Broadland Agricultural Water Abstractors Group (BAWAG) are surrounded by 28 Broadland Special Sites of Scientific Interest, and started to feel pressure to protect supplies when their licences came up for renewal.

The group, which now counts breweries, glasshouses, and processors among its 180 members, cover 22 different water catchments. They work together to ensure they are using their supplies as efficiently as possible, share knowledge and resources, and sub-groups have been set up within BAWAG to target particular locations or issues. Members are moving towards more efficient boom irrigation systems, and five reservoirs are in development.

Andrew Alston, a local farmer, contractor, and Chief Executive of the group, says that when they started there was no support for farmers on this issue in the area. The Group's success shows what can be achieved when farmers work together and, as a testament to this, they were awarded the Environment Agency's Water Efficiency Award in 2007.

Thirty per cent of the water catchments in the UK are over abstracted, and the Environment Agency predicts that demand for water could increase by 25% by 2020. Increasing efficiency of this precious resource is going to be fundamental to a secure and sustainable food supply system in the future.

◆ Madeleine Lewis *(m.lewis@forumforthefuture.org)* co-manages the Farming Futures project at Forum for the Future.

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# VITAL SUSTAINABLE AGRICULTURE – A SOLUTION FOR THE 21ST CENTURY

Biodynamic agriculture can help maintain nutrient levels in the soil. But according to **IBRAHIM ABOULEISH** and **MARTIN HAAGEN** it also has a part to play in combating undernourishment, poverty, environmental degradation and climate change

*'A narrowly-focused "seed and fertiliser" revolution will not avert recurrent food crises' (UNEP 2009)*

Despite high ambitions after the World Summit on Sustainable Development 1992 in Rio de Janeiro the problems of poverty, hunger and environmental destruction are more challenging than ever. The number of undernourished people rose from 856 million to 1.02 billion in 2009, and more than 1.3 billion people live on less than $1.25 a day. Increases in food security have to be addressed in developing countries – with methods suitable for their specific conditions. Global ecosystems also suffer from increasing demands for food, fuels and wood; where 60% are used unsustainably (UN Millennium Ecosystem Assessment) and thereby damage can be irreversible. The excessive use of resources, such as fossil fuels, minerals (e.g. phosphor) and water, as well as the extinction of plants and animals, are a threat for future generations. For the countries in sub-Saharan Africa and the Middle East the water dimension is especially relevant.

Many policies chosen so far are insufficient, and due to their interrelations only holistic approaches can solve these challenges. Therefore agriculture, as the link between undernourishment, environmental degradation and climate change, has a central role. This multifunctionality of agriculture was also highlighted by the latest International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) report *Agriculture at a Crossroads* (2009). However, the 'sustainable' solutions could hardly be more diverse. In broad terms there are two paradigms which both claim to offer the right path.

Industrial agriculture relies on external input, and sophisticated large scale machinery replaces human labour. Furthermore, pesticides and genetically modified organisms (GMOs) play an increasing role. Multinational corporations realise large economies of scale; however, their solutions are mostly not tailored for specific demands.

Biodynamic agriculture, a form of organic agriculture, utilises the synergies of diverse and complex ecosystems by crop rotation and intercropping to help sustain rich nutrient levels in soils, and symbiosis between plants and animals aiding protection from pests. These farming practices demand specific knowledge of the circumstances so there are no one-size-fits-all solutions. If rightly applied, nature provides us with highly efficient and effective solutions.

## Agriculture and climate change

*'Please eat less meat – meat is a very carbon intensive commodity.' (Dr Rajendra Pachauri, joint winner of Nobel Peace Prize 2008)*

The agricultural sector is hit hardest by climate change, with temperature increases, sea level rises and the increase of extreme weather events such as droughts or excessive rainfall affecting valuable lands and crops. Many small scale farmers in developing countries are especially vulnerable, as they often don't have the means to protect themselves or to compensate for losses. In Egypt climate change is a major issue. A sea level rise of only 50 cm could potentially affect more than four million people and destroy large areas of fertile land (Figure 1). Yet, agriculture is also a major emitter of greenhouse gases (GHGs), responsible for around 10-12% of carbon dioxide equivalent (CDE) (Smith *et al*, 2007). The main contributors are nitrous oxide (mainly from fertilisers) accounting for 38%, and methane (mainly from livestock) accounting for 32% of all agricultural emissions (Smith *et al*, 2007).

Furthermore, according to Defra, the production of one ton of nitrogen fertilizer utilises 1-1½t of equivalent petrol. Livestock is also a major driver of deforestation. Finally, the whole food chain of industrial agriculture with long transportation journeys and high refrigeration demands is very energy intensive. Thus, the actual emissions of the whole food system are much higher. These facts are widely known and were recently confirmed in the Cordoba Declaration (2009): 'The current input-intensive agricultural system is struggling under the combined pressures of climate change and food insecurity, exacerbated by large-scale agro-fuel production and increased speculation on land.'

At the same time, agriculture also offers the potential for large mitigation. Globally, soils contains 2,500 Gt of carbon (FAO, 2008) much more than the 800 Gt in the atmosphere (Hepperly, 2003); but soil is currently a net emitter. Sustainable practices can change this trend and induce major net absorptions. Yet, despite the importance of agriculture to global warming mitigation, current negotiation texts of the UNFCCC still fail to take full account of agriculture. This is mainly due to difficulties in measuring and monitoring in diverse conditions. The potential of

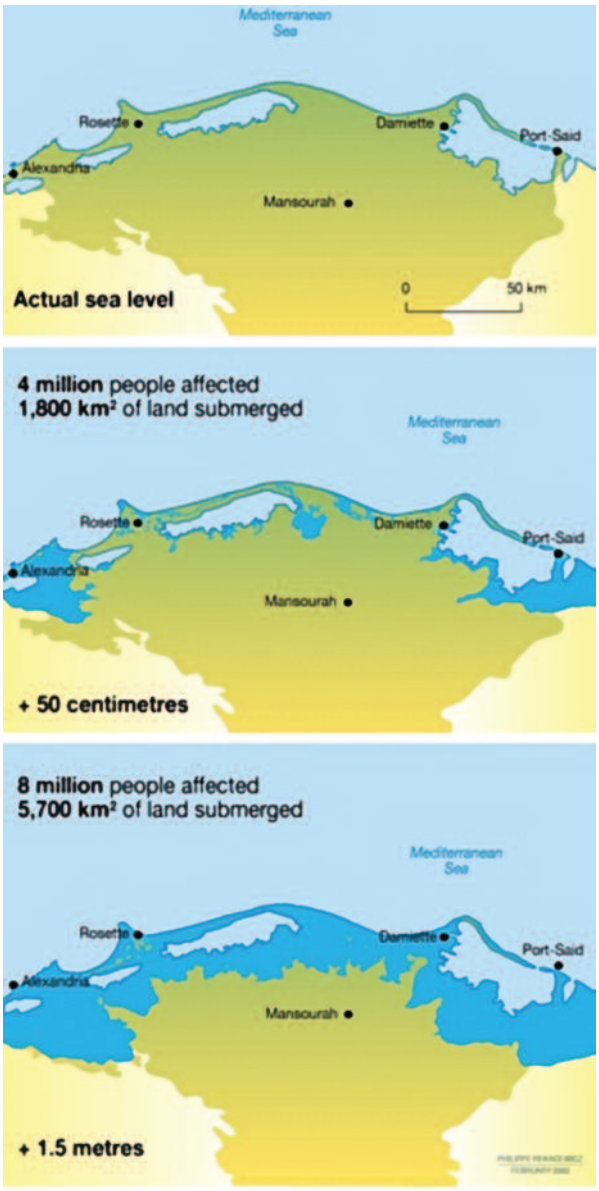


**Figure 1: Impact of sea level rise on the Nile delta** (UNEP/GRID, 2010)

commercial carbon soil sequestration methods also attracted the GMO industry and large financial institutions which see potential for major investments. However, a sole focus on carbon levels sets perverse incentives, by supporting monocultures which undermine the social and environmental capabilities of ecosystems. Thus, if agriculture is included in a global climate treaty, the operational negotiation texts have to give clear priority to the rights of indigenous people, food security and biodiversity.

## Biochar and bioenergy

The constantly growing energy demand as well as the problems associated with fossil fuels led to an increasing importance of energy from biomass. In urban areas large amounts of sewage and green waste provides opportunities for energy production, especially in combined heat and power plants. In rural areas farmers can use their green wastes for the generation of biogas. Being almost carbon neutral, energy from biomass is an important mitigation practice. Another technique which reduces atmospheric $CO_2$ levels is the production of biochar (charcoal made through pyrolysis of organic material which is later buried in the soil). Besides its climatic aspects biochar also increases the carbon content in soils and thereby supports various other beneficial aspects. Some of the most fertile soils in the world, for example the Terra Preta in the Amazonian region, are characterised by high charcoal content. They are rich in nutrients and have a high water holding capacity. Advocates of biochar promote it thus not only in respect to its mitigation aspects but also stress its agricultural advantages. However, this needs to be taken with caution. While most of the effects are yet to be discovered, the biochar lobby already develops scenarios demanding more than 500 million hectares for the production of charcoal and energy.

Given the limited availability of land, this undermines food production. Moreover, large scale, monoculture plantations have disastrous effects for indigenous people and local ecosystems. UNEP (Trumper *et al*, 2009) recommends that '…large-scale biochar deployment is inadvisable.' Policy makers have to develop very sophisticated mechanisms on how these technologies can be fostered without harming people or the planet.

## Agriculture and water

Taking into account the growing population, water availability per capita will decrease in the 21st century. Most countries in the Middle East are living under severe water scarcity (less than 500m³/capita/year) and the excessive use of non-renewable ground water undermines the future of sustainable water sourcing (Figure 2). With a consumption of more than 80% only agriculture can address this issue. However, actual agricultural practices often waste water for short term yield increases through excessive irrigation. Sustainable practices on the other hand offer plenty of solutions which reduce water demands and foster growth simultaneously, for example cover crops and agro-forestry methods reduce the evaporation from soil; and modern irrigational techniques within the soil and sub-soil can further reduce the demand. The largest potential however, lies in healthy soils with high content of soil organic matter (SOM), as in organic agriculture. In India, biodynamic soils have been reported to decrease irrigation needs by 30 to 50% (FAO, 2007).

## Genetically modified organisms (GMOs)

GM lobbyists tell the public that the wisdom of nature alone is insufficient and only genetic engineering will be able to feed the world. Yet, they fail to honour their

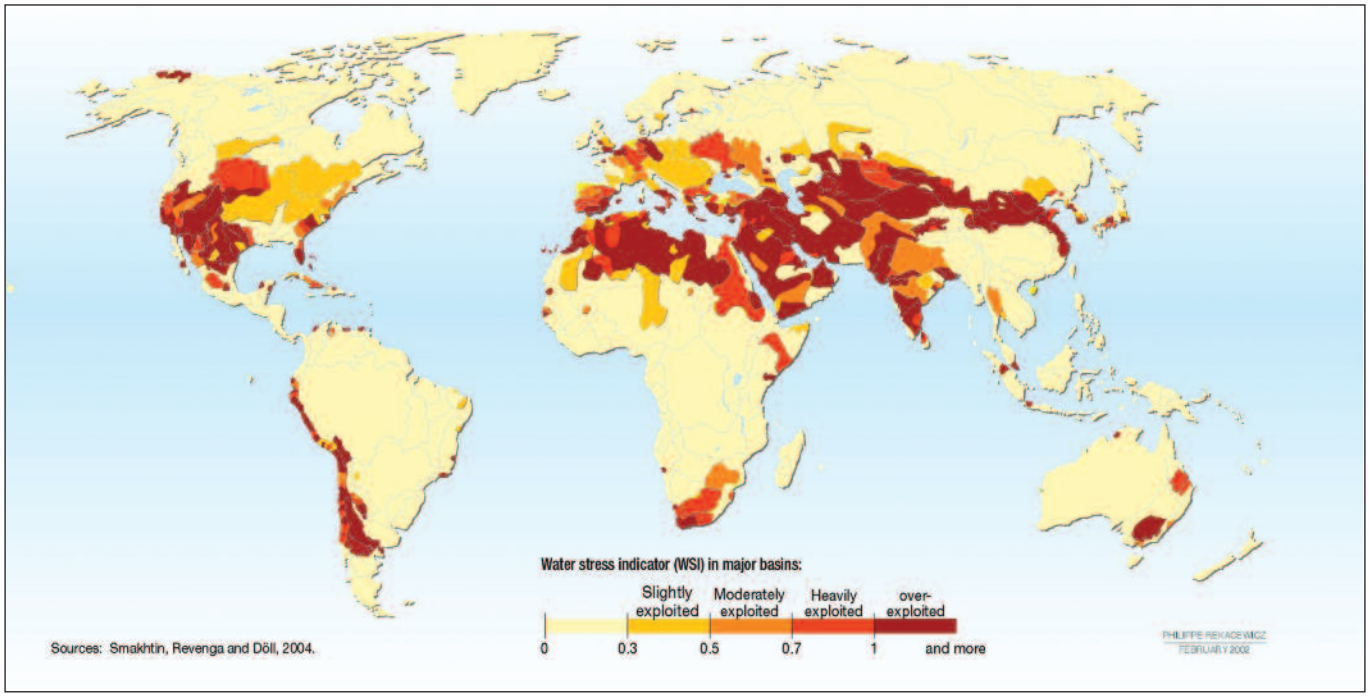


**Figure 2: Water scarcity index** (Smakhtin *et al,* 2004)

promises, as was recently articulated in a report by the Union of Concerned Scientist evaluating the performance of GE crops (Gurian-Sherman, 2009). Despite all the research there are no intrinsic increases of yields and operational increases are not substantive. GM companies promote crops which are resistant against specific pests (e.g. European corn borer) or equipped for droughts, but they have often failed to deliver the promised increased yields.

Evolutionary processes formed organisms which are best adapted for their specific conditions. Therefore such a confined approach with a few crops prepared for such specific conditions could neglect these complex and natural interactions. Highly diverse systems are the most resilient. Nature offers cheaper and more effective solutions. The Incas, for example, developed more than 3,000 different types of potatoes for various climatic and geological conditions (Weatherford, 1989). Today the greatest potential still lies in selecting the appropriate crops and using local planting know-how. It is a much wiser choice to invest in researching the evolutionary potential and providing it to farmers. A dominance of singular seeds, like those promoted by the GM lobby, is also a great threat. It reduces biodiversity and thereby undermines the resilience of whole ecosystems. 'The loss of traditional knowledge and seed varieties in the Global South is a much more urgent crisis, and much more crippling to the world's capacity to address climate change, than what has been the traditional US research model,' said Jim Harkness, President of the Institute for Agriculture and Trade Policy, (IATP, 2009).

## A diet for the planet

*'Changing the ways in which food is produced, handled and disposed… can both feed the world's rising population and help the environmental services…' (UNEP, 2009)*

The persistent undernourishment of more than one billion people remains one of the greatest challenges of the 21st century. This is solely a problem of distribution, not of production. In terms of calories per capita we produce more than enough to feed the world. However, meat and dairy intensive diets, as well as large losses in the food chain, confine availability. Furthermore, water and land constraints will ultimately limit the production potential of foods worldwide.

Egypt is already facing these constraints today. Organic agriculture creates healthy soils, rich in organic matter, which can use water efficiently and provide the basis for high yields. Even when sustainable practices are applied, a shift in diets and a reduction of losses over the supply chain is absolutely essential to address food security (see Figure 3). Meat and dairy intensive diets have much larger impacts on our ecosystems. A kilogram of beef needs almost 16,000 litres of water (Formas, 2008), has a land demand of about 20 $m^2$ and causes $CO_2$ emissions of 15-35 kg (Hirschfeld *et al*, 2008). Wheat on the other hand needs only about 1,350 litres of water (UNEP, 2010), has a land demand of about 2 $m^2$ and causes emissions of roughly 0.25 kg of $CO_2$ (Hirschfeld *et al*, 2008). Rising living standards in many countries increase the demand for these products. Yet our planet cannot hope to feed 7 billion people adopting the current consumption patterns of the

## SEKEM – A COMMUNITY FOR SUSTAINABLE DEVELOPMENT

**SEKEM was founded in 1977, some 60 km north-east of Cairo. With the practices of bio-dynamic agriculture the desert was turned into fertile soils. The seven companies of the SEKEM group produce healthy and environmentally sound food products, textiles and phyto-pharmaceuticals. Yet the SEKEM vision of a sustainable community contains much more. Today its hospital offers medical services for employees and the rural population. Schools, a training centre and a research academy provide education and human development. Adult learning, social and cultural activities are an integral part in SEKEM to develop social forms which reflect human dignity and to strive towards higher ideals. The Heliopolis University for Sustainable Development is currently established to provide students with holistic solutions for the future. In 2003 the SEKEM initiative was honoured with the Alternative Nobel Prize for its business model which integrates social and cultural development.**

industrialised countries. A sustainable diet can only be induced by raising awareness of the impact of our food system on the planet. Ultimately, these issues have to be integrated in international price structures for resources as well as in agricultural subsidies and trade agreements.

## Conclusion: why the current industrial agricultural paradigm fails

Undernourishment, poverty, environmental degradation and climate change are great threats and urgently demand effective solutions. Policy makers have to develop ways to foster multifunctional agriculture, and prioritise agro-ecological methods over large scale industrial production systems. Already today farmers around the world show that organic agriculture, with its manifold benefits, is feasible, especially in developing countries. SEKEM has been practising this for more than 32 years, and has even managed to contribute substantively to the social and cultural development of rural Egypt.

◆ Professor Ibrahim Abouleish received a PhD in Chemistry in 1969 at the University of Graz (Austria) where he was then appointed Head of Division for medical research until 1977. In 1975, on a visit to Egypt, his home country, he became aware of the pressing problems of pollution, overpopulation and education and in 1977 decided to establish SEKEM, a development initiative.

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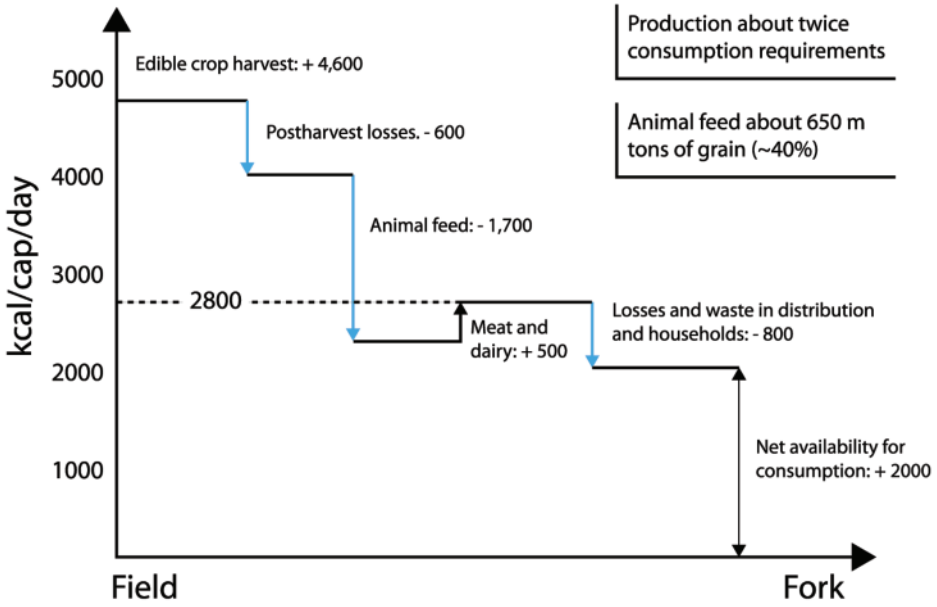


**Figure 3: Losses and conversions: production to consumption** (Lundqvist *et al,* 2008)

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## IES: NEW MEMBERS

The Institution of Environmental Sciences is pleased to welcome the following new members and re-grades:

| | | |
|---|---|---|
| Robert Ainsworth | Geo-Environmental Engineer | M |
| William Allaway | Assistant Consultant | A |
| Jacob Baker | Lecturer in Atmospheric Chemistry | M |
| Andrew Barrett-Mold | Graduate | A |
| Helen Bayliss | Senior Environmental Engineer | M |
| Andrew Bell | UNESCO Biosphere Reserve Co-ordinator and Service Manager | M |
| Hannah Beswick | Air Quality Consultant | M |
| Daniel Birkinshaw | Senior Air Quality Consultant | M |
| Jessica Bott | NAFIS Clerk | Af |
| Andrew Bourne | Regulatory Affairs Scientist | A |
| Jonathan Brookes | Air Quality Consultant | M |
| Kiri Brown | Consultant | A |
| Marco Caminiti | Project Engineer | M |
| Marc Carreras-Sospedra | Post-doctoral Scholar | A |
| Brian Chalkley | Director of Teaching and Learning | F |
| Wing Cheung | Senior Environmental Engineer | M |
| Kam Chow | Environmental Officer | M |
| Robert Cockell | Student | Af |
| Alina Congreve | Lecturer | M |
| Rachel Conti | Senior Policy Officer (Air Quality) | M |
| Kevin Cook | Director | M |
| Benjamin Cornet | Environmental Scientist | M |
| Peter Cottrell | Environmental Scientist | M |
| Tallent Dadi | Health, Safety and Environment Officer | M |
| Gareth Davies | GCMS Analyst | A |
| Philip Dinn | Director | M |
| Calvin Dobinson | Graduate | A |
| Lawrence Eccleston | Consultant | M |
| Susan Eick | Resource and Resolutions Officer | M |
| Simon Elliott | Environmental Scientist | A |
| Andrew Fellows | Environmental Scientist | A |
| Deborah Ferady | Contaminated Land Officer | A |
| Peter Fleming | Air Quality Consultant | M |
| Adam Fuller | Science Technician | A |
| Adam Glass | Environmental Strategy Officer | M |
| Tim Goodall | Microbiologal Laboratory Manager | M |
| Anthony Goslar | Environmental Superintendent | M |

*continued on page 29* ⇨

**KEY:** **F = Fellow** **M = Member** **A = Associate** **Af = Affiliate**

# SOIL CARBON AND ORGANIC FARMING

If all UK farmland was converted to organic farming, at least 3.2 million tonnes of carbon would be taken up by the soil every year – the equivalent of taking nearly a million cars off the road.

**ISOBEL TOMLINSON** of the Soil Association explains

The UK's Climate Change Act commits our Government to delivering an 80% cut in greenhouse gases (GHGs) by 2050. Given that within the EU the food we eat represents nearly a third of our climate footprint as consumers,[1] it is imperative that agriculture takes steps to cut its emissions. To date policy discussions around this have centered on livestock-related methane emissions, nitrous oxide emissions from fertiliser, the potential to generate energy from biofuels, and the anaerobic digestion of animal wastes. The role of sequestering carbon in the soil has been given little attention, despite IPCC's scientific advisors on land use stating that 89% of agriculture's GHG mitigation potential comes from soil carbon sequestration.[2]

In November last year the Soil Association published its report *Soil Carbon and Organic Farming*[3] that is an extensive review of the evidence on the relationship between agriculture and soil carbon sequestration, and how organic farming can contribute to climate change mitigation and adaptation. The research found that on average organic farming produces 28% higher levels of soil carbon compared to non-organic farming in Northern Europe, and 20% higher for all countries studied (in Europe, North America and Australasia). If all UK farmland was converted to organic farming, at least 3.2 million tonnes of carbon would be taken up by the soil each year – the equivalent of taking nearly 1 million cars off the road.

## Soil carbon: a blind spot in tackling climate change

Soil is a major store of carbon, containing three times as much carbon as the atmosphere and five times as much as forests. About 60% of this is in the form of organic matter in the soil (1,500 bn tC). The large size of this store means that soil carbon changes can have significant effects on the level of atmospheric $CO_2$. Soil carbon losses caused by agriculture account for a tenth of total $CO_2$ emissions attributable to human activity since 1850. However, unlike the carbon released from fossil fuels, the soil carbon store has the potential to be recreated to a substantial degree, if appropriate farming practices are adopted. This would remove large quantities of carbon from the atmosphere every year for the next 20 years at least (until a higher 'equilibrium' soil carbon level is eventually reached). Action to increase soil carbon levels can therefore contribute substantially to the efforts to rapidly cut GHG emissions and avoid dangerous atmospheric $CO_2$ increases. Furthermore, raising soil carbon levels can make a vital contribution to climate adaptation, by improving soil structure and quality. This will reduce the impacts of flooding, droughts, water shortages and desertification, thereby also improving global food and water security.

So far, soil carbon is largely being ignored by climate policymakers and analysts in the UK, partly due to the inadequacies of the current agricultural GHG accounting systems. Large (1.6 million tonnes a year) ongoing soil carbon losses from the conversion of grassland to arable land are concealed within the 'LULUCF' (Land Use, Land Use Change and Forestry) category of the UK's greenhouse gas inventory, not acknowledged as emissions from agriculture. With the carbon losses from the fenlands also omitted (an additional 260,000 t C/yr), this means that the actual figure for UK agriculture's $CO_2$ emissions is more than double the official figure of 1.8 million t C/yr, and $CO_2$ accounts for a quarter of agriculture's current official GHG emissions.

There are also major soil carbon impacts of Europe's food and agricultural systems abroad: millions of tonnes of carbon are being emitted from the ongoing conversion of tropical habitats to agriculture in South America to supply soya for the intensive livestock sector and to supply beef in response to the falling UK self-sufficiency in beef (now an annual shortfall of 300,000 tonnes resulting partly from dairy intensification) and from the destruction of high-carbon peatlands in SE Asia to produce palm oil (an ingredient of industrial, processed foods in the UK and other countries).

The UK Government's recently published strategy, *Safeguarding our Soils*, acknowledged that 'preventing emissions from soil and exploring how to increase existing stores of soil carbon can make an important contribution to meeting the Government's emission reduction targets and carbon budgets, introduced by the Climate Change Act 2008.'[4] However, action on soil carbon was deferred in favour of a call for more research: 'We need better evidence on trends in soil carbon levels and cost-effective techniques for protecting or increasing soil carbon.'

The Soil Association report is a response to that chal-

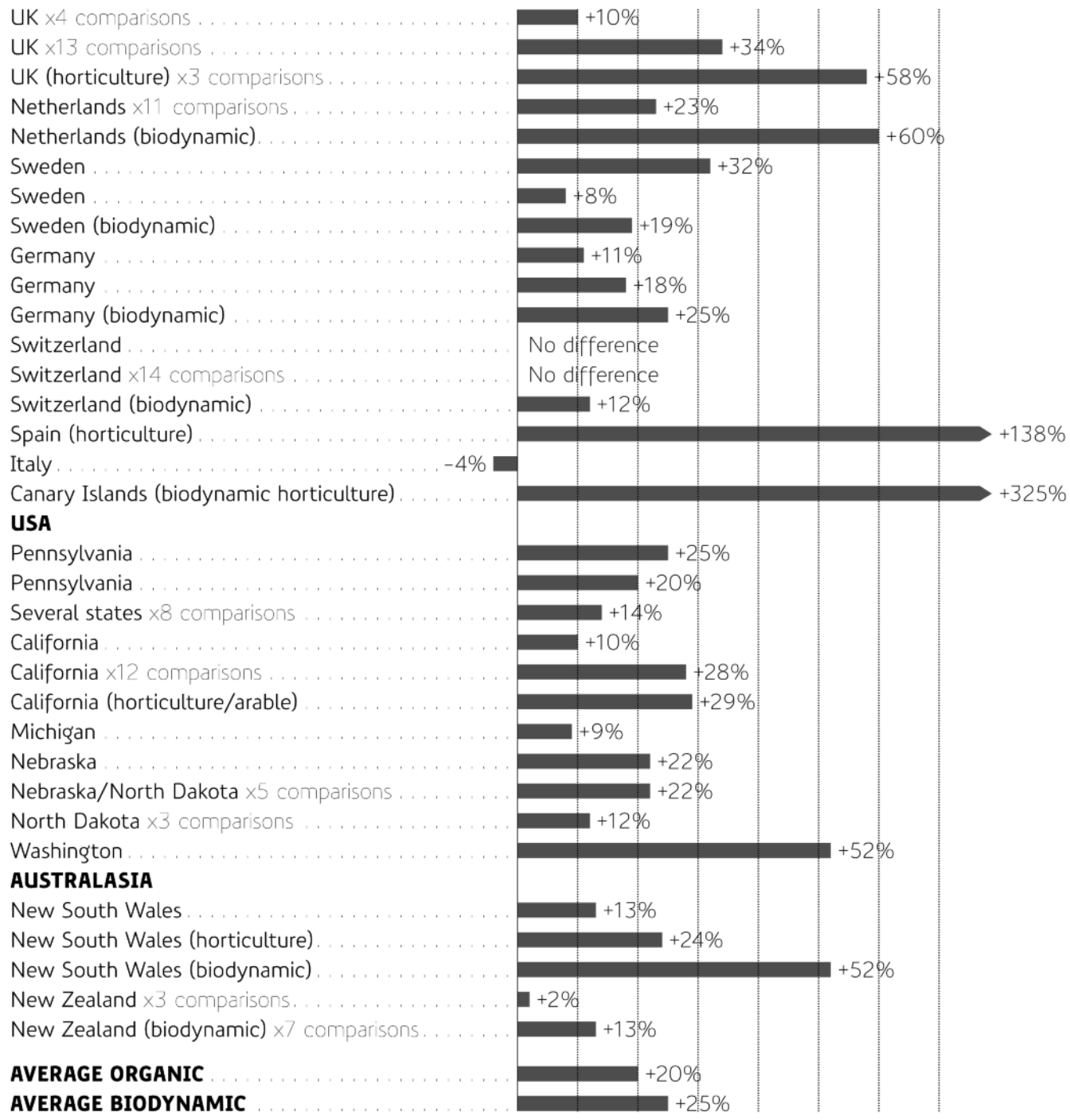


**Table 1: Soil carbon levels: organic farming compared to non-organic** (summary of studies)

lenge. The evidence it presents suggests that action to raise soil carbon levels, through more widespread adoption of organic farming practices and grass based and mixed farming systems, can make a significant and immediate contribution to greenhouse gas mitigation.

## Review of the soil carbon effects of organic farming

The Soil Association undertook a review of 39 comparative studies of organic farming soil carbon levels (all available

soil sampling studies), covering over 100 individual comparisons from many different countries in temperate regions. This included both controlled trials and farm surveys. The objective was to evaluate the real impacts of current organic farming practices, compared to current non-organic farming practices (see Table 1), using the results of studies that sampled organically and non-organically managed land and to be conservative in all assumptions (unless stated otherwise). The results showed that on average, organic farming practices produce 28% higher soil carbon levels than non-organic farming in Northern Europe, and 20% for all countries studied (in Europe, North America and Australasia). This represents a soil carbon sequestration rate of approximately 560 kg C/year (2 t $CO_2$ /yr) for each hectare of cultivated land converted to organic farming in the UK, for at least the next 20 years. This would represent 64 million tonnes of carbon over 20 years across all UK cultivated land, or 3.2 million t C/year.

On this basis, we conservatively estimate that the widespread adoption of organic farming practices in the UK would offset at least 23% of UK agriculture's current official GHG emissions. At a global level, the effects of agricultural soil carbon sequestration are even greater: assuming a higher possible sequestration level of 1 t C/ha/year for organic farming best practices (including composting and agro-forestry), we estimate that widespread organic farming could potentially sequester 1.5 billion t C/year, which would offset about 11% of all anthropogenic global GHG emissions for at least the next 20 years. (The global impact is greater than in the UK because the ratio of the area of cultivated land to total GHG emissions is much higher.)

## Why is organic farming better for soil carbon?

The soil carbon benefit of organic farming results from the fact that the system is based on inputs of organic matter to the soil and the decomposition of this by soil microbial activity for releasing nutrients for crop production, instead of using inorganic fertilisers. This process at the same time produces humus (stable soil carbon) and thereby raises the soil's carbon levels.

A review of the scientific evidence on the factors and biological processes of soil carbon accumulation indicates that there are several key aspects of organic farming that produce these higher soil carbon levels. Firstly, there is the production of additional organic matter sources on farmland (grass leys, green manure crops), normally without reducing the area of farmland that is in food production. This additional organic matter is in forms that are more effective at producing humus and raising soil carbon levels (grass, legumes, root systems, composting and farmyard manure instead of slurry and straw), instead of just arable crop residues which tend to be rapidly mineralised.

The common integration of crop and livestock production (mixed farming) on organic farms ensures the use of temporary grass in the rotations. It also ensures that much more of the livestock waste is produced in farmyard

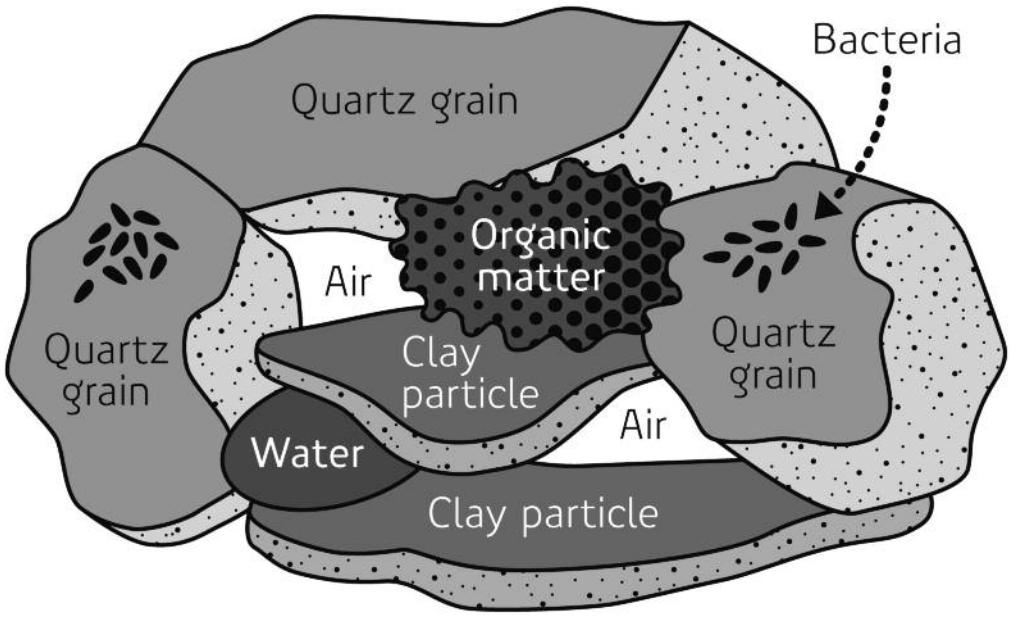


**Illustration of soil aggregation.**
The pore space inside the clump of particles holds organic matter, water and air.

manure (FYM) form (with straw) instead of slurry, and that much more of the collected manures are applied to the cultivated land. Further, the greater vegetation cover and less bare soil of organic systems (due to the use of grass leys, more weeds, green manure/cover crops), provides a greater and more continuous supply of the root exudates that support the soil's micro-organisms which build the soil carbon store.

## The importance of grass-fed livestock

There has been much recent public debate about diet and climate change and whether we should be eating less meat, or what type of meat would be best for reducing GHG emissions. An important distinction should be made between grass-fed grazing livestock and meat from intensive grain-fed animals.

Grass-fed livestock has a critical role to play in minimising carbon emissions from farming and this must be set against the methane emissions from cattle and sheep. This is because grasslands for grazing livestock, whether permanent pasture or temporary grass on mixed farms (which accounts for most UK organic cultivated land), represent vitally important soil carbon stores.

Each year in the UK, 1.6 million tonnes of carbon (representing a hidden additional 12% of the UK's agricultural GHG emissions) are released into the atmosphere because of the net conversion of permanent grassland to cultivated arable land. According to a recent European Commission report, grasslands have the potential to be sequestering large amounts of carbon on an ongoing basis. In the UK, the potential sequestration is said to be 670 kg C/ha/year,[5] which, if true, would offset all the methane emissions of beef cattle and about half those of dairy cattle.[6]

Advocates of a shift from red meat to grain-fed white meat to reduce methane emissions could therefore find that this has the perverse effect of exchanging methane emissions for carbon emissions from soils and the destruction of tropical habitats (to produce soya feed), as well as having a far reaching impact on our countryside, wildlife and animal welfare. Instead, a shift to a diet based on unprocessed, seasonal produce and grass-fed meat in moderation, rather than intensive poultry and pork, would be healthier, and help reduce GHG emissions.

## A bigger role for soil carbon

Critics have been too quick to dismiss soil carbon sequestration on the basis that the rates of sequestration tend to diminish 20 years after a switch to improved practices. However, it is the next 20 years that will be critical in policy terms for delivering major greenhouse gas reductions. Moreover, carbon sequestration still continues thereafter, albeit at lower rates, for 100 years or more.

Current policy aspirations for cutting agriculture GHG emissions are low. The 2020 target for agriculture in the UK's Low Carbon Transition Plan is a voluntary 6-11% greenhouse gas reduction, compared to mandatory 20-40% targets in all other sectors of the economy. Action to raise soil carbon levels through the more widespread adoption of organic farming practices and grass-based and mixed farming systems can make a significant and immediate contribution to GHG mitigation.

◆ Isobel Tomlinson is the Policy and Campaigns Officer for the Soil Association. She was previously a Postdoctoral Research Associate at the Centre for Environmental Policy at Imperial College where she worked on the RELU Project 'Memory and Prediction in Tree Disease Control: A comparative analysis of Dutch elm disease and Ramorum blight in the UK'. She has a PhD in organic farming policy.

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3 Soil Association (2009) Soil Carbon and Organic Farming: A review of the evidence of agriculture's potential to combat climate change – Summary of findings can be downloaded from *www.soilassociation.org*. The full report (200 pages) is also available.

4 *Safeguarding our Soils: A Strategy for England*, Defra, September 2009.

5 'Europe's Terrestrial Biosphere Absorbs 7 to 12% of European Anthropogenic $CO_2$ Emissions', by Ivan A. Janssens, Annette Freibauer, Philippe Ciais, Pete Smith, Gert-Jan Nabuurs, Gerd Folberth, Bernhard Schlamadinger, Ronald W. A. Hutjes, Reinhart Ceulemans, E.-Detlef Schulze, Riccardo Valentini, A. Johannes Dolman. Published on-line in Science, Vol 300, 6 June 2003, *www.sciencemag.org*.

6 UK methane emissions per dairy cattle per year are 130.8 kg from enteric fermentation and from manure. Assuming 2 dairy cattle per ha, this means dairy cattle release: 2 x 130.8 x 21 (conversion factor for methane to $CO_2$) x 12/44 (conversion to carbon equivalent) = 1,498 kg CE/ha/yr of methane. So, UK grassland would give an offset of 670/1498 x 100 = 45% offset. Beef cattle emissions are 39% of those of dairy cattle, per animal. Reference for methane emission data for cattle from page 374 (based on cattle weight 577 kg), Annexes of the UK Greenhouse Gas Inventory, 2007: *www.airquality.co.uk/reports/cat07/0905131425_ukghgi-90-07_Annexes_Issue2_UNFCCC_Final.pdf*.

# CONSERVATION GRADE – NATURE FRIENDLY FARMING

**TIM NEVARD** and **BRIN HUGHES**

outline a way of feeding the growing world population without destroying biodiversity and the environment

Whether or not you agree with man-made global warming, there is no doubt that the world is heating up. Levels of atmospheric $CO_2$ are higher than at any time in the last 440,000 years (source: Met Office) and there is now scientific and political consensus that we have entered a period of unprecedented climate change.

The greatest (and perhaps the only) 'buffer' we have to climate change is the maintenance of the biodiversity of our natural ecosystems. Biodiversity – or biological diversity – means the many and varied forms of life on Earth, from tiny, single-celled bacteria to blue whales, from algae to zebras. As well as diversity of species, there is also diversity within a single species ('genetic' diversity) and diversity of ecosystems (like seas, grasslands, wetlands, forests and lakes).

## Biodiversity loss

To many consumers, the concept of biodiversity (and often the word itself) seems remote. But like all our predecessors, we continue to rely on the diversity of organisms in the natural world for our survival. This biodiversity provides us with food, raw materials, medicines, clean water and fertile soils. Mangrove swamps are the tropical world's primary coastal flood defences, peat bogs soak up carbon dioxide and a country walk is good for mind and body.

However, we continue to damage biodiversity. Species become extinct or are forced into unsustainably small and isolated populations, as tropical forests are cleared for palm oil production, wetlands are drained and seas are over-fished.

In short, we rely fundamentally on global biodiversity but we are not managing it sustainably. Several reports (NEAA, MEA and IUCN) confirm that global biodiversity remains under severe threat with species extinctions occurring at 100 to 1,000 times the historic rate. More than a third of species are estimated to be facing extinction; an estimated 60% of the Earth's ecosystems have been degraded in the last 50 years and there is mounting evidence that the status of many ecosystems is reaching or has already reached the point of no return (Nature, 2009). If we continue to lose species and their habitats, we threaten the very services on which our prosperity and wellbeing depend.

But we need to feed a growing world, and that presents a conundrum.

## Food security and population growth

A major driver of biodiversity loss has been the post-war obsession with obtaining the most food from a rapidly diminishing per capita arable land area at the cheapest possible cost. In the UK we now realise that such an intensive system of farming is not sustainable. Things have improved recently: pesticide use is better-regulated and 'agri-environment schemes' have enabled some farms to become more 'nature-friendly'. However predicted population increases indicate that global demand for food will increase 50% by 2030 and 100% by 2050.

Providing a sustainable supply of food that is affordable, nutritious and safe is therefore the major global challenge for farmers, agri-business, researchers and government. The regions of greatest population growth over the last 50 years have been Asia and Africa and these trends are predicted to continue (UN, 2006). Greater urbanisation has occurred as populations move into cities and as incomes increase, so eating habits have changed. Meat consumption per capita in China increased from 20 kg in 1980 to 50 kg in 2007 (source FAO). This puts pressure on resources as 1,000-2,000 kg of water is required to produce 1 kg of wheat, whereas 10,000 to 13,000 kg of water is required to produce 1 kg of beef.

Population growth rate is now greater than the index of agricultural production and world grain stock (although at far more comfortable levels than they were two years ago) would provide 77 days of consumption (Brown, 2010). But the area of the earth's surface available to grow food crops for today's 6.1 billion people remains at only approximately 3%. That equates to 0.25 ha of available farmland per capita. With limited arable land and a continually growing world population, the available farmland per capita is expected to further decrease dramatically to 0.16 ha by 2050 (UN, 2006).

## Wheat yields – conventional and organic

Yields of conventionally produced wheat in developed countries continued to increase steadily during the 1970s, 80s and early 90s. These increases were in line with scientific advances in conventional breeding technologies, together with improved efficacy of pesticides and crop nutrition. But those increases have ceased in recent years with many farmers now struggling to increase outputs beyond what appears to be the maximum realisable capacity.

Yields of organic wheat crops are consistently lower than conventional, suggesting an even lower capability of organic crops to feed the growing population. Figures

from Elm Farm Research Centre, the primary organic research institute in the UK, indicate that the average UK organic winter wheat yield (assessed from data on many farms) is c. 4 tonnes/ha but averages are c. 8 tonnes/ha for 'conventional' agriculture; a yield ratio of 0.5 (Goulding and Trewavas, 2009).

Record conventional wheat yields are c.14-15 tonnes/ha. Occasionally organic yields have reached 7 tonnes/ha; again suggesting an organic/conventional yield ratio of 0.5.

## Biofuels

Carbon dioxide emissions from the burning of fossil fuels and their contribution to climate change are well documented. Hence, the development of biofuels from crops is seen by some as a way to mitigate climate change. Brazil leads the world in production and use, making about 16 billion litres per year of ethanol from sugarcane. The European Union had a target for 2010 that 5.75% of transport fuels should come from biological sources (although this target is unlikely to be met). The British government's Renewable Transport Fuel Obligation requires 5% of the fuel sold at the pump by 2010 to be biofuel. And in the US, the Renewable Fuel Standard aims to double the use of biofuels in transport by 2012.

Thankfully, the pitfalls of biofuels are now well known: turning plants into fuel is often more polluting than burning petrol, and using crops for fuel when millions are starving is hard to justify. From the environmental point of view, the big issue again is biodiversity. Rainforests are being destroyed for biofuel crop production in Brazil and for palm oil plantations in Indonesia and Malaysia, at the expense of some of the world's most biodiverse habitats. We share 97% of the DNA of the orang-utan but we have destroyed 80% of its habitat for palm oil production – if we allow one of our closest cousins to go extinct what hope is there for us?

## Global ecosystem services

The economic costs associated with these losses of biodiversity have only recently begun to be investigated. The annual loss of ecosystem services is estimated at 50 billion euros, and by 2050 the cumulated welfare losses are estimated to be equivalent to 7% of GDP (COM, 2009). Proper valuation of ecosystem services is therefore essential and to that end the international study, The Economics of Ecosystems and Biodiversity (TEEB), will release a report in summer 2010 aimed specifically at the business sector. The report will provide guidance for the development of EU policy on prevention of biodiversity loss and will help businesses understand and take advantage of new opportunities to create value within a new and growing green economy.

## Consumer solutions

At present, food production in developed countries is very efficient when measured in strict financial terms, but we are 'in the red' with our debt to nature and increasingly the global economic impacts of biodiversity losses are becoming clearer. To pay back that debt we need to use land in ways that do not reduce biodiversity further. One solution is for consumers to choose only food products that are farmed sustainably – just as they did in the 18th century when they chose to avoid buying sugar grown by the socially unsustainable and morally reprehensible system of slavery.

By making a sustainable choice again, consumers could use their purchasing power to influence the development of social, environmental, health and animal welfare values in the food system and make sustainability a matter of competitive advantage for the those food brands which offer sustainable choices to their customers.

The 'Conservation Grade™' certification system of 'nature friendly farming' provides food brands, producers and consumers with a unique, sustainable solution to efficient food production while enhancing biodiversity and preventing wildlife declines on farmland.

## Conservation Grade: nature friendly farming

Conservation Grade is a unique sustainability protocol implemented by farmers in return for a contracted premium price for their crop.

Independent scientific trials demonstrate the Conservation Grade farming system leads to significant increases in biodiversity compared to conventional agriculture (Figure 1). At the same time food production output is maximised in terms of yield and quality.

| | |
|---|---|
| **BIRDS** | Numbers up 41% (and new species introduced) |
| **BUTTERFLIES** | 8-fold increase over crop (22 species) |
| **BUMBLEBEES** | 13-fold increase over crop |
| **MAMMALS** | 30-fold in some habitats (water vole and other increases) |
| **PLANTS** | Generally increased, especially rarer annuals |
| **BEETLES AND SPIDERS** | Up to 100-fold increase in some habitats |

**Figure 1: Increases in wildlife species on Conservation Grade farms.** During a three year experiment, increases in individual species were recorded and summarised (Conservation Grade, 2003).

All Conservation Grade farmers have access to a supply contract for their produce for which there is a guaranteed premium over the market price in return for implementing the protocol standards. Because of this commercial continuity, Conservation Grade creates a model for both profitable farming and practical wildlife conservation.

The processor or brand owner uses the Conservation Grade logo on all products as approved by Conservation Grade Producers Ltd. This provides a significant environmental point of difference to help in the marketing of its products for which brand owners pay a licence fee or royalty on any product carrying the Conservation Grade logo.

Conservation Grade farmers are required to take 10% of their land out of food production to develop a specific range of habitats for wildlife on their farmed land. The habitats must be created and managed in the ratios prescribed to create the optimum conditions to promote biodiversity on the farm. These include:

**4% pollen and nectar;** e.g. wildflowers and clover, normally planted in field margins, to provide insect food and habitat.

**1.5-2% wild bird food;** using plants like quinoa and fodder radish that provide seeds for birds in winter and early spring.

**2% tussocky and fine grasses;** providing shelter for spiders, beetles and small mammals (and food for predators like barn owls).

**Up to 0.5% natural regeneration areas;** for the encouragement of rare arable annual plants and ground nesting birds.

**2% land that is a unique feature of the individual farm** that can be managed to promote wildlife; for example, hedges, ditches, old barns, ponds or woodland.

Conservation Grade farmers are required to exceed the requirements for current government environmental stewardship schemes: for example, in the current UK environmental stewardship scheme, Entry Level (ELS) Option EG3 nectar flower mixture, the maximum area required is 3% (3ha per 100ha of arable land); whereas Conservation Grade farmers are required to provide 4% of farmed area as pollen and nectar habitats. The Conservation Grade protocol also imposes a compulsory structure for habitat placement, instead of a menu of prescribed habitat options. This ensures an appropriate balance of specific habitats on the farm to provide the best support to local biodiversity.

## Conclusion

2010 is the International Year of Biodiversity and the growing awareness of the implications of biodiversity loss is driving it to the forefront of the economic and environmental agenda in much the same way that climate change has moved centre stage over the past decade.

The analysis on the cost of biodiversity loss and ecosystem degradation already emerging from the TEEB initiative is providing leaders in both business and government with much needed information on which to base key decisions at corporate and national level.

Agricultural production is reliant on biodiversity and ecosystem services and the trend for certified sustainable agricultural products to enhance brand value and differentiate products with consumers will continue and grow.

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# OPINION
## A NEW DEAL FOR LOCAL ECONOMIES: A VIEW FROM THE USA

The relentless rise of the superstore has increasingly characterised America's car-driving society. But now local enterprises are making a comeback. **STACY MITCHELL** sees social, economic and ecological reasons to welcome the return of the independent trader

Locally grown food has soared in popularity. There are now 5,274 active farmers' markets in the United States; remarkably, almost half of these markets were started within the last decade (USDA, 2009). Food co-operatives and neighbourhood greengrocers are likewise on the rise. Independent businesses in many cities are organising and building an increasingly powerful counterweight to the big business lobby on issues as varied as tax policy and global warming. Local business alliances have now formed in over 130 cities and collectively count some 30,000 businesses as members (New Rules Project, 2010). These alliances are calling on people to choose independent businesses and locally produced goods more often, and making a compelling case that doing so is critical to rebuilding middle-class prosperity, averting environmental catastrophe, and ensuring that our daily lives are not smothered by corporate uniformity.

There is growing evidence that these initiatives are succeeding. Last winter, as the economy spiralled downward, many big retail chains reported double-digit sales declines forcing bankruptcy upon some. However, a survey of 1,100 independent retailers determined that revenue was down just 3% on average (Department of Commerce, 2009). What accounted for this relative good fortune? Many of those surveyed said that more people are deliberately seeking out locally owned businesses.

Evidence to date indicates that people's priorities are changing and therefore many of the largest global corporations are trying to determine how they can be 'local' too. Hellmann's, the mayonnaise brand owned by the processed-food giant Unilever, is test-driving a new 'Eat Real, Eat Local' marketing campaign. Winn-Dixie, one of the largest supermarket chains in the US, has a new slogan: 'Local flavour since 1956.' Most astounding of all, Starbucks, a company that has spent millions developing one of the most recognisable brands on the planet, is now beginning to un-brand some of its outlets. The first of these just reopened as '15th Avenue Coffee and Tea' in Seattle and, unless customers read the fine print on the menu, they could quite easily assume to be in an independent coffee house. Corporations want to turn the local economy movement into a cheap marketing trick they can appropriate for their own ends. Due to current public consciousness, this corporate green-washing, or 'local'-washing, could potentially backfire. After all, these companies spend enormous sums on market research and they would not be de-branding unless they had detected a sizeable shift in public attitudes.

### Historical trends

While signs abound that people are rediscovering the benefits of an economy rooted in community and small-scale enterprise, all of this activity, though widespread, is still relatively modest. It exists largely on the margins and is unlikely to coalesce into a wholesale reorganisation of our economy unless economic rules are changed. We tend to imagine that our economic system is the product of a kind of natural evolution, the inevitable result of forces as innate and inexorable as the weather. But in fact our economy is largely the consequence of public policy. Governments have made rules that privilege the global over the local, concentrate ownership, and undermine democracy.

This unholy alliance between central governments and powerful corporations has continued right down to the present day, but with a few noteworthy setbacks along the way. One such example is the American Revolution during the late 18th century, which began in earnest when a group of colonists forced their way onto three ships docked in Boston Harbour and dumped more than 90,000 pounds of tea into the sea. The colonists' actions were as much a challenge to corporate power as they were a rebellion against King George III. Those ships were owned by the East India Company, which had been losing money in the colonies in part because of growing competition from local tea merchants. Parliament stepped in and passed the Tea Act, which exempted the East India Company from the taxes that its smaller rivals had to pay. The assumption was that the lure of cheaper tea would outweigh any loyalties the colonists had to their local merchants. But Parliament and the East India Company misjudged. The Boston Tea Party and the Revolution itself were thus acts of both civil disobedience and corporate sabotage (Hartmann, 2004).

In the decades following the American Civil War, Americans remained highly suspicious of economic concentration. Thomas Jefferson even proposed making 'freedom from monopolies in commerce' part of the Bill of Rights. Although his proposal failed, the early republic still placed strict limits on the power and longevity of corporations. Thus it is not about people creating and exchanging real value. Corporations exist not to create value, but to extract it. When mega-retailers, like Wal-Mart or Tesco, move into a community, their aim is not to

enrich the local inhabitants, but to eradicate local businesses and to sever the economic relationships that link the people of a community together. In place of this robust system of local trade and mutual benefit, the big superstores erect a single-track economy in which wealth flows in only one direction: out.

How is it that we have so willingly accepted such colonisation? We acquiesce in large part because long ago we stopped conceiving of ourselves as citizens, with all of the authority and responsibility that role entails. Instead we adopted the highly circumscribed role of 'consumer'. This is how we are referred to by corporations, the media, our elected officials, and even ourselves. We have internalised the logic of corporations. When we became consumers, 'the pursuit of happiness' – a Thomas Jefferson phrase – 'ceased to be a collective, public endeavour'. It was no longer about seeing friends at a pub, strolling the high street on a warm evening, or joining with one's neighbours to address a community need. Instead the pursuit of happiness became confined to the narrow realm of individual consumption. People no longer relied on their neighbours so much as competed against them. 'A life devoted primarily to the pursuit of material ends,' Fritz Schumacher observed, 'necessarily sets man against man… because man's needs are infinite and infinitude.' Consequently, today we find ourselves not only on the brink of environmental catastrophe, but increasingly alienated and unhappy. Einstein was right that 'no problem can be solved from the same level of consciousness that created it.' And so we must begin by reclaiming our citizenship.

## Re-establishing 'local'

About ten years ago, the Institute for Local Self-Reliance launched the New Rules Project to develop and advocate for policies that would democratise ownership, refashion the economy for long-term sustainability, and nurture strong self-conscious and self-governing communities. Three areas of policy reform are especially critical as shown below.

Firstly we must resurrect and embrace a vigorous anti-monopoly policy.

If we were to boil the financial crisis down to its root cause, we could sum it up rather succinctly as the 'curse of bigness,' to use former Supreme Court Justice Louis Brandeis's phrase (1934). The crisis was caused by massive industry consolidation, which invariably leads to destructive corporate behaviour, because the decision-makers at these vast institutions are so far removed from the impacts of their decisions.

A generation ago, with Reagan and Thatcher telling their electorates there was no alternative, Britain and the US dismantled anti-monopoly laws on the ground that bigger is more efficient. Competition policy became concerned solely with short-term impacts on prices and abandoned any consideration of the corrosive long-term consequences of concentrated power. Thus we have the

unchecked growth of Tesco, which has nearly one-third of the British market (Garner, 2008), and Wal-Mart, which captures nearly one in four dollars Americans spend on groceries. These power buyers now control so much of the market that suppliers have only two options: they can shun them and try to survive by selling to a shrinking number of other retailers; or they can submit themselves to the chains, which will lead to more revenue but ever thinner margins. Of Wal-Mart's top ten suppliers in the mid-1990s, four have sought bankruptcy protection, while others have merged in a bid to stay afloat (Lynn, 2006).

All of this has led to a profound loss of economic flexibility as the entire global system of production is refashioned to serve these multi-national corporations. The food, drugs, clothing, and other goods we rely on are now made in a relatively small number of places and transported over long and highly centralised supply lines. As Barry Lynn (2006) has written, monopsonies (where one buyer faces many sellers) are 'slowly freezing our economy into an ever more rigid crystal… that every day is more liable to collapse from some sudden shock.'

Given the ecological challenges we face, we can ill afford an economy that is the biological equivalent of a monoculture. We need the inherent creativity and adaptability of a multitude of small-scale enterprises that can evolve quickly and better respond to the unique circumstances of their own regions. Competition policy must embrace diversity as its primary aim. It must return to the idea that the measure of a competitive economy is not some abstract notion of efficiency, but rather that a competitive economy is, by definition, one made up of many competitors.

The second proposal is that we need to adopt planning policies that support local economies.

In the USA after World War II, federal and state officials poured money into highway construction, dismantled public transit, guaranteed mortgages in the suburbs but not in the city, and enacted planning rules that insisted on a rigid separation of residential and commercial uses. All of this created a landscape ideal for chains and big-box stores, but inhospitable to local businesses. In recent decades, municipal governments have gone even further, doling out hundreds of millions of dollars a year in subsidies and tax breaks that directly underwrite the construction of shopping centres and superstores. Most Americans, as well as a growing number of Europeans, now find themselves living in a built environment that is ill-suited to a post-carbon world, in part because it fails to support a local economy and in part because it demands an extraordinary amount of driving. Between 1987 and 2007, total miles driven in the US rose 60% (United States Department of Transportation).

This problem is self-reinforcing, because the landscape that the car has created only entrenches us ever more firmly in our role as consumers and erodes the social capital that enables communities to innovate and solve complex problems like global warming. The conventional explanation is that people are rediscovering local food. That's certainly true. Perhaps people are as hungry for the community experience as they are for the fresh broccoli? Perhaps it's this social pleasure that is driving the very modest, but noteworthy, regeneration of local businesses in some communities. Little shops are not only a hub of social activity. It's also an economic engine of surprising proportions. Studies show that spending a pound at an independent business generates about three times as much benefit for your local economy as spending a pound at a chain. The reason is that, unlike chains, which siphon money out of a community, local businesses spend much of their revenue buying goods and services from other local businesses. They bank at a local bank, hire a local accountant, and get their printing done at the local print shop (Civic Economics, 2009 and Institute for Local Self-Reliance 2003).

Local ownership enables a face-to-face economy. It closes the distance between customer and owner, farmer

and eater, manufacturer and user. This local shop is also significant from a climate standpoint. One study in Seattle found that families living in neighbourhoods that integrate small businesses with homes drive 26% fewer miles on average than those living in areas that lack nearby shops (Frank, 2005).

But this local store and the others like it that have managed to survive are like little green shoots growing up in the cracks of a sidewalk. They are defying the odds in a planning system rigged against them. If we want to grow a whole new crop of these kinds of businesses, we must rethink our planning policies. We need to stop favouring the automobile at the expense of other forms of transportation and stop green-lighting superstore development.

A growing number of cities in the US are indeed prohibiting the construction of superstores, and some, like San Francisco, are restricting the proliferation of all types of chains. At the very least, we need to adopt a kind of precautionary principle that places the onus on big retailers to demonstrate that their shops will be a net benefit, both economically and environmentally. We have enacted a policy like this in my home state of Maine, where large shops no longer have the right to open, but may do so only after their economic impacts have been independently evaluated and the community has determined that the benefits outweigh the costs.

Third and last, we need new mechanisms for channelling our investment capital in directions that nurture community and rebuild local economies.

How can we reconnect capital with community needs? Global warming has created an urgent need to retool much of our infrastructure, develop regional food systems, retrofit buildings, re-establish neighbourhood enterprises, and so on. And yet our system for pooling and deploying capital is completely ill-suited to this task, oriented as it is to maximising short-term gains rather than building long-term community capacity. A useful model, which relies on a mix of public and private investment, is Pennsylvania's Fresh Food Financing Initiative. This $120 million fund has provided low-interest, long-term loans to finance more than 60 locally owned food markets in neighbourhoods and small towns that lacked places to buy fresh food. All but one of these shops has succeeded, demonstrating that the reason 'food deserts' exist in so many low-income communities is not that grocery shops are not viable in these areas, but rather banks have been reluctant to finance these ventures. We ought to build on this model by establishing similar funds to capitalise a new generation of neighbourhood shops, small-scale farms, and other enterprises that can expand the capacity of communities to meet more of their needs locally.

Financial institutions are not the only way to link local capital with community enterprise. A growing number of local businesses are being financed directly by their customers. In the US, Community-Supported Agriculture schemes, or CSAs, which enable people to fund the operations of a farm in exchange for a share of its harvest, have multiplied to well over 3,000.

## Conclusion

Many political and corporate leaders are eager to put the financial crisis in the rear-view mirror and return to business as usual. But we should not let them. More than ever, we need a new economics fashioned from the wisdom of Schumacher. We need a bold new deal that reorients antitrust, planning, and financial policy to shrink the power of corporations, resurrect citizenship, nurture local enterprise, and build a sustainable future.

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# CLIMATE FRIENDLY FOOD – INTRODUCING A COMMUNITY-LED LABELLING SCHEME

Climate-friendly labelling allows food producers to move away from fossil fuels and retailers to purchase from low-carbon suppliers. **JENNY HALL** believes it will also give them a market advantage

The food we eat accounts for 30% of the UK's carbon footprint, according to a report published by WWF-UK and the Food Climate Research Network (Audsley *et al*, 2009). Previous estimates put the figure closer to 20%, but this study is the first to incorporate land use change overseas, increasing the estimate of emissions attributed to food consumption in this country. Given the impact of food consumption on the UK's overall emissions, a radical change to the country's food system is needed to help reduce the scale of emissions from the food chain.

The report assessed various scenarios that explored what these changes might look like. Both technological and behavioural initiatives were tested, including decarbonisation of the energy used in the food chain, improved efficiencies and changes in consumption of meat and dairy products. As one of the authors Tara Garnett, head of the FCRN, said: 'We now know enough to conclude that the food system contributes very substantially to the problem of climate change. We also know enough about where and how the impacts arise to start doing something about them. Business as usual – and even business as usual 'lite' – is no longer an option.' The report explores options for a 70% greenhouse cut by 2050. While this is a daunting task, it is not an impossible one. New food labelling can offer a signpost to this new approach.

## Carbon sequestration

Carbon concentration in the atmosphere is increasing at the rate of about 2 parts per million (ppm) per year, with transfer primarily from the fossil fuel and soil pools (Lal, 2009). The UK is legally committed to reducing carbon emissions by 80% by 2050 in order to help stabilise atmospheric $CO_2$ at 450 ppm (global $CO_2$ levels are currently at 387 ppm *(CO2now.org, 2009)*. One positive solution is to absorb atmospheric $CO_2$ into soils and plants; this is called carbon sequestration.

Britain's 'wildwood' existed for about 7,000 years, from the post-Ice Age warm-up right through medieval times, when it was said a squirrel could cross England without touching ground. The soils of these natural forests contained at least 10% organic matter (supported by symbiotic mycorrhizal fungi) but, since clearance to make way for agriculture, this has reduced to an average of 3.5% organic matter and in some intensively farmed arable land is just 1%. This decline is ongoing through the long-term use of extractive farming processes.

The potential of carbon sequestration is higher in degraded soils and restoring peat bogs. According to Professor Ratten Lal (2009) the technical potential of carbon sequestration in world soils may be 3 billion tonnes per year for the next 50 years – the equivalent to a draw-down of about 50 ppm of atmospheric $CO_2$ by 2100. Sources of compost, manure, biosolids, green manures, chipped branch wood, biochar, lignin root exudates, mycorrhizal association and restoring wetlands offer the greatest potential for soil sequestration. Putting the many approaches to food production into simplistic categories and making sweeping generalisations about their merits and faults has led to farmers feeling that their methods are unfairly criticised. In every category, conventional, organic, biodynamic, horticulture, agroforestry, smallholder, urban and biointensive there is good practice. Producers need encouragement to be part of the solution by reducing their $CO_2$ emissions and sequestering more carbon. This universal aspect of good farming could perhaps be called 'rich-soil farming.'

## Emissions

While counter-intuitive to those in the organic community, the dichotomy of 'conventional' high-carbon emissions and 'organic' low-carbon emissions per functional unit of output (i.e. per tonne of food) is not apparent. Compared with intensive production systems, more extensive systems have lower emissions associated with inputs and processes per area of land, but also have lower yields per area of land, and livestock take longer to reach slaughter age, with the result that emissions per functional unit are often similar (ADAD, 2009).

However, organic systems have the greatest potential to be low carbon food systems if they can achieve comparable yields. In the UK, this is the case with biointensive crops of fruit, nuts and vegetables (Jones and Crane, 2009) from orchards, agroforestry, forest gardens and organic market gardens. These biointensive systems tend to have the highest calorific output per hectare (even on more marginal soils) (Griggs, 2010) of all foods and are important for feeding populations. Also all organic systems tend to use less fossil fuels (Kopke and Haas, 1996), primarily because of not using Haber-Bosch nitrogen, and therefore will be more resilient in the face of peak oil.

## Third sector contribution

Climate Friendly Food (CFF) is a not-for-profit social enterprise that was set up by commercial growers concerned about the 'business as usual' attitude in the food

sector. The Cabinet Office (2008) found 'existing patterns of food production are not fit for a low-carbon, more resource constrained future… existing patterns of food consumption will result in our society being loaded with a heavy burden of obesity and diet-related ill health.' CFF was set up to support a paradigm shift towards low-carbon food that provides for the needs of healthy populations.

## Community consultation

In August and November 2008 CFF conducted two national consultations with 120 respondents who were largely producers:

- 84% felt there was a need for a carbon standard for food
- 71% thought it was the true mark of sustainability
- 74% of farmers and growers are motivated by improving carbon practices

The November consultation was more specific about what should be measured:

- 87% wanted to substitute renewable energy for fossil fuel energy
- 85% felt a key goal was the localisation of the economy
- 76% wanted biological GHG emissions like nitrous oxide measuring
- 97% wanted off-farm GHG impacts of manufactured inputs, e.g. horticultural fleece, measuring
- 64% wanted GHG impacts past the farm gate

## Certifying producers

Climate-friendly food labelling is a new scheme, started in the UK, which offers opportunities for farmers and growers (producers) to:

- adopt climate mitigation behaviours;
- move away from fossil fuels and become more resilient in the face of peak oil;
- connect to the science of climate change;
- commit to year-on-year improvements; and
- achieve market advantage.

It also enables:

- retailers to purchase from low-carbon suppliers;
- consumers to purchase low-carbon produce; and
- the UK to meet international obligations for greenhouse gas mitigation.

CFF's certification mark is linked to behaviours as opposed to the carbon footprint *per se*, principally because high-carbon emitters are in the strongest position to make large carbon savings. This is different from other carbon labelling schemes as many of those schemes just display the carbon footprint of a food product without benchmarking. Organisations like Consumer Focus have argued that carbon labelling without context, letting a consumer know whether it is good or bad, is confusing to consumers. Instead we have created a label that is more decisive, one that lets consumers know how hard their farmers and growers are working to create ultra low carbon food systems. There is no doubt that there is a culture of label overload, yet as an organisation we are confident that carbon footprinting will become the primary indicator of sustainability within a decade.

## Key behavioural improvements

All producers agree to abide by the low-carbon policies which will support:

- **Fuels** – movement away from fossil fuels, movement towards renewable energy, movement from liquid fuel towards electric vehicles;
- **Fertility** – movement away from brought-in inputs towards closed biological systems, movement away from Haber-Bosch nitrogen fixation towards biological nitrogen from legumes, reduction of worst nitrous oxide effects; peat-free propagation;
- **Materials** – movement away from brought-in inputs towards closed-systems, biological control of pests and diseases, movement away from fossil-fuel intensive materials, e.g. concrete, use of second hand equipment, reduction in the size of machinery and other capital inputs;
- **Livestock** – movement towards growing all feed, fodder and forage on farm, movement away from slurry, feeding ruminants grass only, feeding monogastrics on crop waste;
- **Distribution** – movement towards re-localised food systems, where produce is neither refrigerated nor processed. The ultimate in these decentralised systems will be where customers buy from the farm gate on foot/cycle, or delivery is direct from the farm to a local community hub where customers pick up on foot or cycle; and
- **Sequestration** – movement towards enhanced recalcitrant soil organic matter content, biochar mixed with compost, perennial food crops, biomass sequestration from more hedges, trees and having uncultivated areas.

## Our future plans

CFF is still in its early stages of working with producers to get them engaged with carbon footprinting. The carbon calculator for farmers and growers is free of charge and we hope that all producers will begin to understand how to reduce their carbon footprint. We are planning to provide more technical support through writing publications, running workshops, organising mentoring schemes and running Assessment and Qualifications Alliance (AQA) Unit Awards in various aspects of low carbon food systems. We are currently negotiating a tenancy for a demonstration farm where we aim to showcase all the latest low carbon technology including electric tractors and agroforestry feedstocks for renewable energy and biochar.


◆ Jenny Hall (*www.climatefriendlyfood.org.uk*) is the Director of Climate Friendly Food. She gained her MSc in Environmental Policy in 1998 at Lancaster University and has worked for twelve years as a grower, community development worker, qualified teacher and consultant supporting community food.

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## IES: NEW MEMBERS

⇨ continued from page 15

| | | |
|---|---|---|
| Paul Grimes | Health, Safety and Environmental Manager | A |
| Richard Harada | Graduate | A |
| Adam Hayward | Graduate | A |
| David Hector | Specialists Consultant – Air Quality | M |
| Jason Hoyte | Contaminated Land Consultant | M |
| Enan Keogh | Air Quality Consultant | M |
| Brian Kerr | Student | Af |
| Ludovic Lemaignen | Senior Consultant | M |
| Alaric Lester | Director | M |
| Trevor Lowans | Volunteer | A |
| Ellyse Maddocks | Environmental Scientist | A |
| Roger Martin | Managing Director | A |
| Claire Meddings | Environmental Scientist | M |
| Daniel Moon | Air Quality Consultant | A |
| Jessica Muirhead | Senior Air Quality Consultant | M |
| Martina Mullarkey | Group Environmental Specialist | F |
| Lorna New | Graduate | A |
| Betty Ng | Technical Director | M |
| Alex Nowell | Graduate | A |
| Gareth O'Brien | Post-graduate Student | A |
| Aveez Olowoporoku | PhD Researcher | A |
| Otareh Otareh | Chief Executive | A |
| Cullum Parker | Planning Officer | Af |
| Russell Payne | Graduate | A |
| Philippe Pernstich | Customer and Project Advisor | M |
| Kanan Purkayastha | Senior Scientific Officer | F |
| Jethro Redmore | Senior Environmental Consultant | M |
| Nicholas Reynolds | Senior Environmental Geologist | M |
| Alice Rhodes | Postgraduate Student | A |
| Robert Sellen | Assistant Planning Policy Officer | A |
| Peter Shaw | Senior Lecturer | F |
| Karl Sheeran | Graduate | A |
| Timothy Simmons | Sustainable Construction Manager | M |
| Kimberlee Simons | Student | Af |
| Timothy So | Student | Af |
| Mark Spence | Chairman | Af |
| Adam Sutlow | Graduate Air Quality Consultant | A |
| Robert Tinsley | Senior Executive Consultant | M |
| Keith Tipping | Senior Planning Officer | M |
| Sara Turnbull | Sustainability Consultant | M |
| Marina Tzima | Environmental Scientist | M |
| Konstantinos Tzoulas | Senior Research Officer | M |
| Yasantha Urugamuwe Gamacharige | Post Doctoral Research Associate | M |
| Howard Walker | Consultant | Af |
| Jennifer Ward | Specialist Consultant | A |
| Philip Ward | Environmental Engineer | M |
| Peter Watson | Owner | A |
| Robert Watson | Chief Scientific Advisor | F |
| Jennifer Weir | Principal Consultant | M |
| Martin Wilson | Co-Director, Historic Environment Consultant | M |
| Naomi Wise | Graduate | A |

**KEY:** **F = Fellow** **M = Member** **A = Associate** **Af = Affiliate**

# SUSTAINABLE FOOD AND FARMING: CAN LABELLING HELP?

Take the percentage of sodium – multiply it by 2.5 – multiply the answer by your portion size… **KATH DALMENY** suggests we need a more helpful form of food labelling if we are to tackle the growing nutritional problems of the population

Improved food labelling is generally understood to be one of the tools for enabling a more sustainable food and farming system. It could, so the theory goes, prompt consumers to use their purchasing power to influence the development of social, environmental, health and animal welfare values in the food system. It could help to show which products support UK farming livelihoods and the market for local food. Provided in an appropriate format, it could help to differentiate sustainable and less sustainable products; in turn providing added value, stimulating innovation and making sustainability a matter of competitive advantage.

At the simplest level, people often see food labelling as a way of enabling 'informed consumer choice'. It provides a primary interface between the food industry (farmers, food producers, manufacturers and retailers) and their customers, and is therefore a valuable space to display communications, marketing descriptions and special offers, as well as legally required details and useful information about health and the environment.

Unfortunately, a focus purely on labelling to drive up food standards can also signal complacency about corporate and government responsibility for improving the food system. Food labelling can be used as a fall-back for politicians who wish to 'leave it to the market' or 'leave it to consumers' to choose between damaging and less damaging products. Food labelling can therefore be used as a means of avoiding direct responsibility, or side-stepping a more interventionist approach to achieving public benefits. This is particularly concerning given the twin problems of obesity and climate change – both problems closely associated with unsustainable consumption in the food system – and both too big to fix by labelling alone.

In the past, different labelling requirements have reflected the changing concerns of society. For example, in the 19th century, one of society's main concerns was to ensure that food companies did not 'adulterate' food by adding fake ingredients, and the laws reflected this, and continue to reflect them through rules on composition, food names and ingredients lists. The laws reflect a narrow focus of concerns.

In the 21st century, society's concerns are changing, and so are the rules. For legal controls over food safety, there are international and national bodies that set the food laws and labelling rules, with enforcement officers at national and local levels. Other issues, such as the nutritional value of processed food, are often left to voluntary agreements with food companies. But as food-related health conditions such as obesity and heart disease have grown to epidemic proportions worldwide, organisations such as the UK's Food Standards Agency (FSA) are now getting increasingly involved in the design and communication of nutrition information. They recognise that systems favoured in the current laws for listing ingredients by precise name and positioning on the label are generally designed to prevent fraud, and have little to offer us in terms of protecting public health through better nutrition.

It is worth examining the issue of nutrition labelling in more detail. UK law does not require nutritional information on packaged food, but where it is used, it must be in a prescribed format. This is based on a technically correct, precise and numerical format for showing the number of grams of fat, sugar or sodium per portion of food. However, such information turns out to be less than useless to the majority of the population, who are generally unconfident with manipulating or interpreting numbers. A memorable and ironic press release from the government recently informed us that 50% of the population don't know how to interpret percentages. And what success in nutrition information can we expect for a population with a wide range of ethnic and educational backgrounds, when their salt information is provided in technical terms? The sodium number, for example, must be multiplied by 2.5 to find the salt level, which must then be multiplied again by the portion size to find the amount consumed, which in turn must be related to the percentage Guideline Daily Amount; some labelling only expresses amounts as a percentage of the GDA. Confused? You wouldn't be alone.

Instead, and sensibly, government has recognised the growing nutritional problems of the population, and the inadequacy of numerical nutrition labelling to address this. The government has now begun to favour a colour-coded nutrition system that ascribes 'red' to high-fat, high-salt or high-sugar foods, and 'green' to those that have a healthier nutrition profile. This aids communication. Labelling is about information, but also about helpful interpretation to encourage preferred behaviours. Interestingly, the industry literature also shows that when consumers see a row of 'red marks' on their sandwich or

ready meal, they are able to make a rapid judgment and shift to another product. This is already affecting product formulation. Supermarkets would prefer their labels to carry more 'amber' and 'green' labels. Hence labelling has prompted a shift in industry practice.

However, UK nutrition labelling has also demonstrated time and again how political food can be. Some supermarkets and manufacturers have refused point-blank to adopt the traffic light scheme. Notably, those companies who specialise in high-fat, high-salt and high-sugar foods have taken up their adamant position on the 'no traffic lights' side of this great divide, despite FSA evidence that colour-coding helps consumers make better and easier choices. Unfortunately, although the FSA's traffic light scheme has gained acceptance by several leading food manufacturers and supermarkets, several others have rejected the scheme in favour of a numerical Guideline Daily Amount (GDA) system, with no colour coding or interpretation of nutritional information in terms of 'high' or 'low' amounts.

The National Heart Forum, the umbrella body for heart health charities in the UK, published an assessment of numerical GDA labelling in February 2007 (National Heart Forum, 2007). This report systematically assessed GDAs on food and drink packages and concluded that 'GDA signals are not the optimum method for helping consumers make quick, informed choices', for six reasons:

- The GDA values do not distinguish maximum, minimum and average recommended amounts.
- GDA values for adults and for children are used inconsistently, and adult GDAs are sometimes used on child-targeted products.
- The GDAs used for labelling are based on values which are not the most suitable either for public health policy or for individuals.
- The GDA displays are based on arbitrary portion sizes.
- GDA signals for different nutrients are sometimes included or left out in an arbitrary and confusing manner.
- The standard GDA signals lack colour coding for quick consumer appraisal and interpretation.

The need for a single, unified front-of-pack nutrition labelling system has been set out by many health, consumer and regulatory organisations over the years and was one of the key policy drivers recommended by the Health Select Committee enquiry into obesity in 2003. If you are in any doubt about the need for a unified system, imagine being a teacher trying to explain to children the plethora of labelling systems that currently exist.

At the same time, UK government and consumers are also becoming interested in how their food choices affect farmers' livelihoods here and in developing countries. Over the past year or so, carbon labelling has been announced by several food manufacturers, and in a new scheme from the Carbon Trust, based on comprehensive life-cycle analysis of greenhouse gas emissions. Meanwhile, consumer purchases of other food labelled with sustainability values has never been more popular, including Fairtrade and local foods. Over the next few years, we can expect to see policy-makers and the food industry taking an ever greater interest in how to promote products that improve the sustainability of the food system.

But for policy-makers, the question arises: how and where should we intervene in the marketplace to encourage choices that support public policy goals? Some hope that an increasing interest in sustainability (especially climate change, farmers' livelihoods, sustainable fish, fair trade, animal welfare) will drive the market towards sustainable food, and market reports suggest there is an encouraging momentum building. On this basis, many, particularly from the food manufacturing and retail sector, argue that we must look to consumers to drive demand. Certainly, many organisations are now working to raise consumer awareness of critical issues, giving education, advice and promotional support on how to find and buy more sustainable options.

'UK nutrition labelling has demonstrated time and again how political food can be. Some supermarkets and manufacturers have refused point-blank to adopt the traffic light scheme'

In the area of sustainable fish, robust and scientifically-based certification now exists in the form of the Marine Stewardship Council eco-label, which identifies fish products from fisheries that meet UN Food and Agriculture Organisation guidelines for responsible fishing that take into account sustainable fishing methods and an ecosystem approach to stock management. On the down side, endangered fish species can sit beside the sustainable fish, on the same supermarket shelf, innocently sporting no logos at all. The unsustainable options appear to be neutral and continue to be purchased, while the sustainable options are picked out as 'different', and require a change in shopping habits. Recognising this weakness, some of the more responsible retailers, including some (though not all) of the 'top four' supermarkets are now removing the worst offenders in terms of unsustainable fish. They euphemistically call this 'choice editing', which seems to be the industry's comfortable word for a ban.

On the other hand, some issues – notably greenhouse gas emissions – are so complex that informed choice is currently only an aspiration, and consumers and the industry have been thrown back on inadequate rules of

thumb to do little more than *guess* at what may be the most sustainable options. If a logo appears on your packet of crisps to tell you that it represents 35g of carbon dioxide equivalent emissions, are you really in a position to decide whether that is bad or good? The best thing about carbon labelling turns out to be the fact that companies, in the process of undertaking a life-cycle assessment of their product, find out where the greenhouse gas emission hotspots lie, and can take action to improve them. The label provides a level of exposure that prompts such change, but it has so far not proved very useful in prompting changes in consumption away from greenhouse gas intensive products. Further, companies producing products with a very bad greenhouse gas footprint (notably products from livestock, whose climate change hoof-print is enormous – beating even global transport emissions) are loathe to expose their products in this way, fearing customer reprisal.

More importantly, can we rely on consumers to choose their way, product by product, out of consumption patterns that exacerbate climate change? And should we place the whole burden of choice on them to do so? Food is responsible for at least 20% of the UK's greenhouse gas emissions, according to the Department for the Environment, Food and Rural Affairs and the authoritative Food Climate Research Network (FCRN). In research published this month, FCRN has increased this estimate to 30% of all UK consumption-related emissions, when land use change for agriculture is taken into account. The implications of our food choices are fundamental to our future health and well-being, and the ability of the planet to sustain us. Set in this light, how complacent should we be about the ability of labels to change our culture? On such a complex issue, consumers have already expressed their confusion, and Food Standards Agency and Carbon Trust surveys suggest that consumers feel they need to place their trust in the retailer or food manufacturer to have taken responsibility for greenhouse gas emissions, and that the most damaging products simply shouldn't be available.

To address issues of verification and consistency of approach, some progressive companies are now interested in 'sustainability scoring' across a broad range of sustainability issues, which could be used to rate whole companies. This could also be for the purposes of enabling certification, accreditation, regulation, public reward (e.g. tax incentives or contract awards for public procurement) or for consumer communications such as marketing and labelling. A multi-issue scoring system is already used by the National Food Institute in Denmark (government body) to assess companies and products for their sustainability, used alongside price as a decision-making tool for public procurement (Sustainable Food Laboratory, 2007). Scoring systems allow a range of sustainability issues to influence the overall 'sustainability profile' of products and industry practices, allowing for example development benefit to mitigate other factors such as food miles. Sustain has been experimenting with ways that such scores could be portrayed graphically, to show what might be possible (Figure 1).

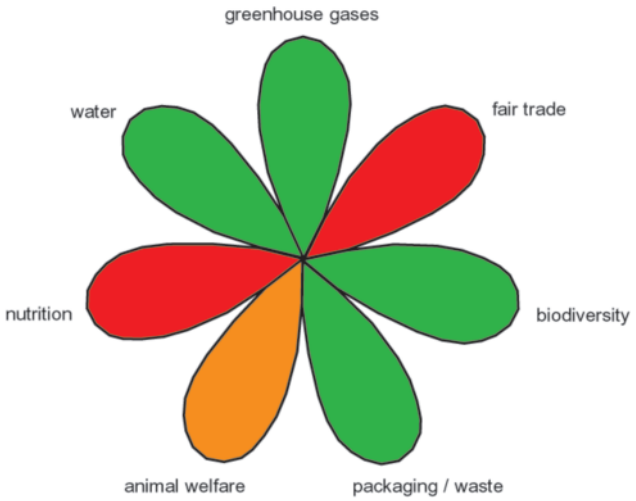


**Figure 1: Food sustainability covers several factors, which might seem daunting for labelling purposes. However, each issue could be represented as the petal of a flower, and rated or colour-coded according to progress on key issues.**

The tone of this article may suggest to readers that labelling is not considered by the author to be a panacea for a more interventionist and responsible approach by industry and government. However, it is one tool in the toolbox for moving production and consumption along the path towards a healthy, ethical and sustainable future. So we should use it well.

◆ Kath Dalmeny *(kath@sustainweb.org)* is a food campaigner and consultant to organisations such as the Food Commission, National Consumer Council and the London Development Agency. In 2009 she became a member of the Food Advisory Group to the London Organising Committee of the London 2012 Olympic Games. Kath is also a trustee of Growing Communities, a London community-run box scheme and farmers' market and Food Matters, a food consultancy that supports individuals and organisations working towards sustainable, equitable food systems. She has a Masters in Food Policy from the Centre for Food at City University.

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