

Food, energy and the future of farming

The world is changing... Fifty years on from the post-war 'green revolution' when technological developments enabled massive increases in yield to feed a growing population, a new challenge is developing for the agricultural sector. Population continues to grow – up to nine billion of us worldwide will need to be fed by 2050 and the raw materials that power our productivity and growth are in limited and diminishing supply. The sector is also tasked with putting up a robust response to the issue of climate change – reducing greenhouse gas (GHG) emissions as well as adjusting production methods to a warmer and more variable climate.

Whatever you think about climate change, it has become an issue that as a farmer, grower or land manager you cannot afford to ignore. Farming and land use were together responsible for emissions of 48.4 million tonnes carbon dioxide equivalent (CO₂e)¹ in 2008, or about 7.7% of total UK greenhouse gas emissions (in the form of nitrous oxide, methane and carbon dioxide). Livestock, fertilisers, and fuel use in farming cause most of these emissions. The remainder are from changes in natural carbon balances caused by the way land is used and managed. Given these emissions, the agricultural sector in England now has its first GHG reduction target from Government – a cut of 11 per cent by 2020.

Key players in the food system, from Government and retailers down to the consumer, are already changing the way they do business and as farmers and land managers you need to keep up with the pace. The good news is that many of the actions you can take in response to climate change can save or make you money, at the same time as helping reduce a range of other environmental impacts from food production.

There are unique challenges to reducing agricultural emissions:

- There are significant uncertainties in estimating agricultural emissions and predicting the effects of changing practices. For example, the amount of nitrous oxide released from spreading fertiliser can depend on the soil type, the weather conditions, when and how the spreading was done, and many other factors;

- There are physical limits to how far emissions from agriculture can currently be reduced, because farming involves complex biological cycles;
- The UK imports and exports food and agricultural products, and this will continue in the future. But reducing domestic emissions reductions should not simply result in transferring those emissions overseas.

Your customers

The market for more environmentally responsible products is changing, with 54 per cent more consumers buying these products than two years ago³. Food is the product for which most information is sought, with 41 per cent of consumers often or always seeking environmental credentials. Interest in local food has also increased with 30 per cent of consumers saying they have specifically brought local food in the last month, double that in 2006⁴. Many such surveys are now showing that the way consumers think about their food choices are changing.

Most of the major retailers in the UK now have specific programmes of work addressing the sustainability of their supply chains and several are specifically targeting climate change and reducing their carbon footprint. These changes are about improving the efficiency and resilience of their businesses as well as delivering what a growing number of consumers want. By taking steps to reduce the environmental impact of your business, you could benefit from this trend.

¹ The unit of measurement used to compare the relative climate impact of the different greenhouse gases. The CO₂e quantity of any greenhouse gas is the amount of carbon dioxide that would produce the equivalent global warming potential (Source: The Carbon Neutral Company)

Energy

Since the industrial revolution, our economic and population growth has been powered by fossil fuels. Fossil fuels are the product of hundreds of thousands of years of organic matter breaking down and forming carbon-rich substances such as coal, oil or gas. These supplies are finite – the UK became a net oil importer in 2006 and North Sea gas supplies peaked in 2000.

In early 2010, the UK Industry Taskforce on Peak Oil and Energy Security (a group of UK companies concerned about energy security issues) launched a report called 'The Oil Crunch' in which they drew attention to oil shortages, insecurity of supply and price volatility. They predict the combination of these factors will destabilise economic, political and social activity within five years. Ofgem reported in 2009 that from 1999 to 2008, oil prices quadrupled while UK gas and coal prices doubled.

The productive agricultural systems we have today have been made possible by the availability of cheap energy, and the use of fertilisers, which are produced from and with fossil fuels. As a farmer you can benefit from using energy more efficiently and generating your own renewable energy, which can reduce costs, diversify your business and reduce GHG emissions.

What the scientists say...

Climate change is part of the Earth's natural dynamic system. Climatic fluctuations have been happening for thousands of years, and will continue to happen in the future. Greenhouse gases (GHGs) such as carbon dioxide, methane and nitrous oxide are released by natural processes and act to regulate the global climate system. We need these gases to keep the planet at a habitable temperature, as without them Earth would be about 30°C cooler. This is a scientific principle based on the laws of physics.

However, rapid population growth and industrial development since the 18th Century has resulted in more GHGs being released into the atmosphere than otherwise would have occurred². This has affected the ability of the planet to regulate itself through natural processes, resulting in the accelerated pattern of climate change we are witnessing today.

The impact of a changing climate on the planet is complex, as temperature change affects many other natural and human processes, either directly or indirectly. There will be variability and unpredictably in different regions and at different times. So while the overall trend in the UK may be towards hotter, drier summers and milder, wetter winters, there will be increasingly unpredictable variations and extreme events such as the cold spells of winter 2009. Variable weather should not be confused with climate change, as climate change refers to long-term trends (>30 years) and weather extremes (some contrary to climate trends) will always exist within these long-term trends.

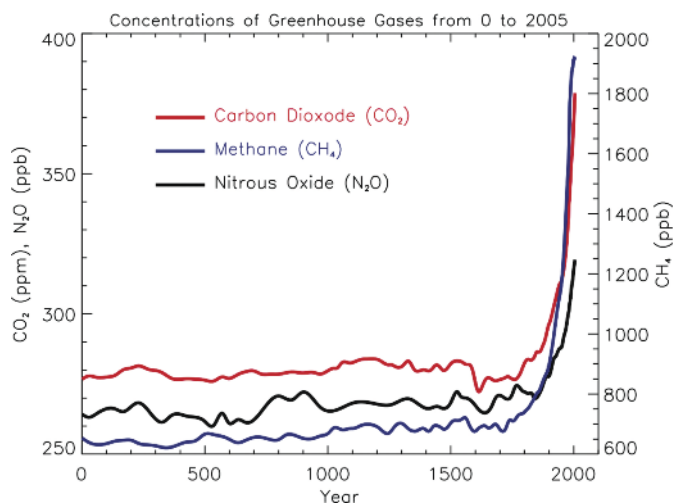


Figure 1: The graph illustrates how atmospheric concentrations of the three main GHGs (related to human activity) have changed over the last 2000 years, with a significant rise occurring since the industrial revolution.

2 In 2005, levels of CO₂ had increased by 35 per cent, methane by 148 per cent, and nitrous oxide by 18 per cent compared to pre-industrial concentrations (IPCC Fourth Assessment Report (2007), The Physical Science Basis).

3 Consumer Focus (2009), *Green Expectations: consumer's understanding of green claims in advertising*.

4 IGD (2010), *Food Trend Report*.

5 http://www.decc.gov.uk/en/content/cms/publications/lc_trans_plan/lc_trans_plan.aspx

6 GWP is a measure of how much a given quantity of gas contributes to global warming compared to CO₂. It is dependent on the timescale involved – typically the GWP is given for a timeline of 100 years. For example, nitrous oxide has a GWP of 298 over 100 years. That is, over 100 years, it is 298 times more potent as a greenhouse gas than CO₂.

Reducing future climate change

In a 2010 Farming Futures survey 48 per cent of farmers and land managers said they were already taking action to reduce future climate change. The UK is now legally bound to reduce GHG emissions by 80 per cent (compared to 1990 levels) by 2050 and a series of 'carbon budgets' has been set to achieve this goal.

In the *Low Carbon Transition Plan*⁵ published in 2009, Government tasked the agricultural sector in England to reduce emissions by three million tonnes CO₂e (roughly 11 per cent) by 2020. As farming and environmental affairs are devolved, Wales, Scotland and Northern Ireland are setting their own targets.

So where does the sector currently stand? Unlike most other sectors of the economy, it isn't carbon dioxide that's the primary problem, but other GHGs. Approximately 50 per cent of agricultural emissions

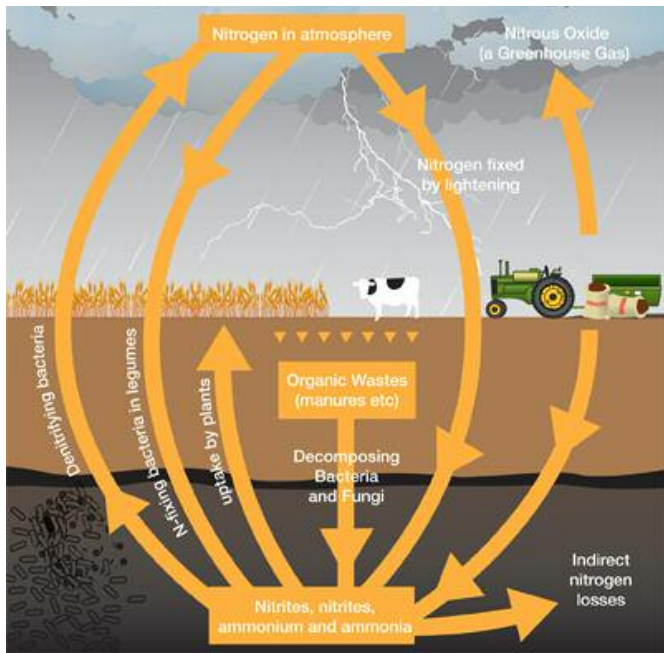


Figure 2: Illustration of the nitrogen cycle and the various fluxes and processes, which lead to the emission of nitrous oxide into the atmosphere from agricultural practices.

are nitrous oxide and 40 per cent are methane. Just 10 per cent is CO₂. Therefore it is nitrous oxide and methane where the big GHG savings will be found.

Nitrous oxide has around 298 times the Global Warming Potential⁶ (GWP) of CO₂. It is released during the production of manufactured fertiliser and as a consequence of biological nitrogen fixation as well as the use of manufactured and organic fertilisers in agriculture. The transformation of nitrogen-containing molecules to release gaseous nitrous oxide and nitrogen gas is part of the natural process of nitrogen cycling, which takes place in soil, water and decaying organic matter. As part of a natural and complex biological cycle, nitrous oxide cannot be entirely eliminated from the system. But nitrous oxide production can be reduced through methods of manure and slurry application, better nitrogen utilisation in crop and grassland production systems and attention to drainage and soil structure.

Methane has 25 times the GWP of CO₂ and is released from the digestive systems of ruminant livestock and from manures and slurries. This meat and dairy debate has hit the headlines recently and demonstrates how these issues (though often oversimplistically communicated) can capture the public's attention. Again, we cannot eliminate methane production from farming, but it can be reduced per unit of production through improved livestock health, modification of animal diets and breeding.

Carbon dioxide is released by burning fossil fuels (e.g. fuel in tractors, farm vehicles, machinery and the production of agricultural chemicals),

disturbance of soils and changes in land use and land management. A lot of carbon is locked up in our soils, particularly peat soils, so protecting soil carbon is also very important.

The impacts of man-made climate change are already here...

In the 2010 Farming Futures survey, 38 per cent of farmers said that climate change was having an impact on their land now, and 57 per cent said they expected it to have an impact in the next 10 years.

As well as reducing GHG emissions, you need to prepare your business for the changes in climate expected over the next few decades.

Between 1961 and 2006, the UK has experienced an increase in annual average temperatures, typically between 1.0 and 1.7°C. This warming has come hand in hand with a reduction in the number of days of air frost, with typically between 20 and 30 fewer days of air frost per year compared to the 1960s. There are also observed trends of increasing winter and declining summer rainfall.

Scientists say these trends are projected to continue, but changes will vary across the country due to regional and local geography. While there will be variations in how climate change impacts different parts of the country, some trends are highly probable.

Summers will be hotter and drier

By the 2020s, average summer temperature in the UK is expected to increase by 1.5°C, but by the end of this century, average summer temperature could

>>

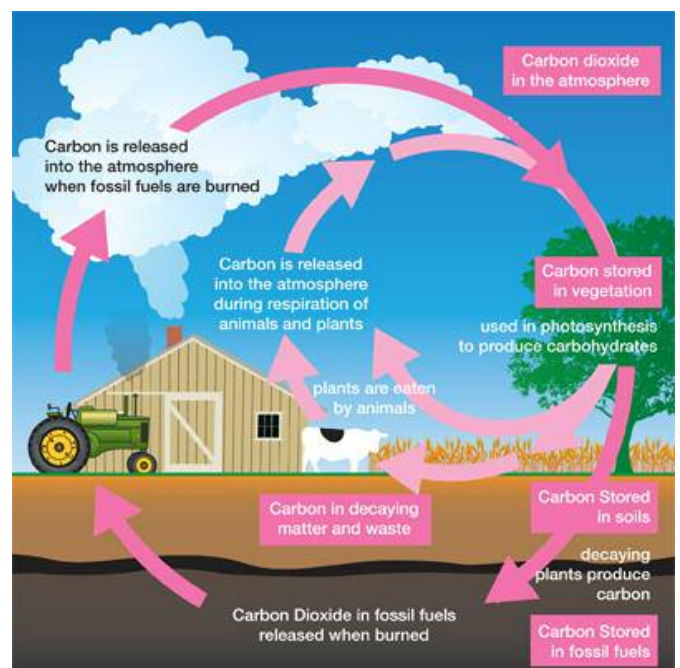


Figure 3: illustration of the carbon cycle of a farm and the various fluxes and processes that lead to emissions of carbon dioxide and storage of carbon in soils and biomass.

be over 5°C warmer. Summer rainfall could decrease by around 10 per cent by 2020 and by 20-50 per cent by 2080. These changes are likely to be most prominent in the South and East of the UK.

Seasonal timings will change, growing seasons lengthen and new crops may become viable, but there will also be less water available for crops and livestock, more pests and diseases and greater risk of heat stress affecting animal health and welfare.

Winters will be milder and wetter

By the 2020s, the average winter temperature in the UK is expected to increase by up to 1°C, but by the end of this century could be over 3.5°C. Winter rainfall can expect to increase by up to 10 per cent and by 10-35 per cent by the end of the century. Frosts will decrease overall but late frosts and extreme cold snaps like in winter 2009 will still occur intermittently and unpredictably.

Extreme weather events

Extreme events will be more likely, with storms, flooding and drought events occurring more frequently, increasing the risk of soil erosion, water pollution and damage to farm infrastructure, stock and crops. Sea level will continue to rise (up to 68cm in southern England by the end of the Century) with the likelihood of coastal inundation and salinisation of coastal land increasing.

While climate projections estimate the change likely to occur, the best way you can prepare is to build resilience and flexibility into your business plan to cope with a range of possible outcomes.

You can find out more about projected changes in climate from the UK Climate Impacts Programme, www.ukcip.org

A new 'low carbon' world...

As a result of the trends outlined in this fact sheet, there are both opportunities and challenges that farmers need to consider when running and developing their business.

Opportunities

- On-farm renewable energy generation
- More efficient food production, through improved management of resources (e.g. nutrients, soil, water) will improve your bottom line
- Cost savings from resource recycling (capture – storage – reuse) solutions (e.g. rainwater harvesting)
- Your 'lower carbon' and environmental credentials could become attractive to new and emerging consumer trends
- A warmer climate and longer growing seasons could improve your productivity
- Developing markets for alternative agri-products (e.g. exotic or non-food crops)

Challenges

- Producing food sustainably for more people, with less resources (particularly fossil fuels) and less impact on the environment
- Functioning as part of a global food system and dealing with climate-induced market volatility
- Reducing GHG emissions and taking adequate measures to protect the environment
- Building the resilience of your business to cope with extreme weather events
- Demonstrating that farming is part of the climate change solution
- Acting now to avoid future regulation (e.g. Campaign for the Farmed Environment)
- Making optimum use of your land and resources – whether for food production, energy generation or provision of ecosystem services

**FARMING
FUTURES**

Visit www.farmingfutures.org.uk to find out more about these issues. On the site you'll find factsheets, case studies of farmers who are already taking action, and information about our series of free on-farm events across England.

With thanks to: Forum for the Future, AHRF, AIC, CLA, Defra, FWAG, LEAF and NFU.