Reducing emissions of greenhouse gases from agriculture

It is estimated that agriculture accounts for about 9% of the UK's total greenhouse gas (GHG) emissions. However, carbon dioxide (CO_2), from energy use on farms and horticultural enterprises, accounts for only about 8% of these emissions. Most GHG emissions from agriculture are either nitrous oxide (N_2O; 57%), or methane (CH_4; 35%) - both important greenhouse gases that contribute to global warming and climate change.

Whilst reducing greenhouse gas emissions has a significant environmental benefit, it can also reduce costs and help to save money through improved efficiency. Below we give some examples of actions that can reduce GHG emissions and improve business performance.

Nitrous oxide

Agriculture is the largest source of nitrous oxide emissions in the UK, contributing around 84% of the total. Emissions of nitrous oxide arise from microbial activity in the soil following application of nitrogen (N) fertilisers and livestock manures to land. Nitrous oxide is about 300 times more powerful than carbon dioxide as a greenhouse gas, so emissions have a high impact.

Farmers should aim to optimise nitrogen usage to improve emissions intensity i.e. produce less emissions per unit of output. It makes economic and environmental sense to ensure that the nitrogen in slurries and manures is efficiently utilised and the need for costly inputs reduced.

Measures to reduce Nitrous Oxide emissions

Include clover in grass mixes

Clover has been used as a component of grass swards for many years, but for some farmers there is an opportunity to improve efficiency by including clover seed in grass mixes and better managing the clover component. Good management can save mineral N costs and reduce the cost of spreading; this has the additional benefit of saving GHG emissions from fertiliser manufacture and spreading.

Clover can be included in a seed mixture when a field is re-seeded by spring broadcasting into the sward or by including clover seed in the feed ration for spread in the dung during grazing.

Good management is important: clover can be slow to start growing in the spring, and the application of mineral N to stimulate grass growth can cause the grass to out-compete the clover. However, some modern clover varieties are able to compete with grass and with the application of up to around 80kg/ha of mineral N. Too much clover in a sward is also a problem, in certain conditions this will cause bloat and needs careful management.

Grow triticale instead of wheat

Triticale requires less nitrogen than wheat, so offering lower fertiliser costs, higher yields and lower GHG emissions. At present the market for Triticale is smaller and less reliable than the wheat market, but in the future it is likely that animal feed markets will adapt to use triticale grain.

Ensure that the crop-available N in organic manures is fully taken into account when deciding on N fertiliser application rates

This has been advocated for many years to reduce fertiliser costs and the risk of nitrate leaching, and it is a requirement under the Nitrate Vulnerable Zone (NVZ) regulations. Guidance for complying with the NVZ rules can be located on the GOV.UK website. Recent evidence indicates that the recommendation from PLANET and RB209 are being adopted and N fertiliser applications are being reduced when manures have been applied. Nevertheless, there may be further scope to reduce this

further. Both PLANET and RB209 have guidance on how the available N in manures can be increased by using application techniques that reduce ammonia emissions. Farmers should adopt a Nutrient Management Plan even if their land is not in a NVZ - http://adlib.everysite.co.uk/adlib/defra/content.aspx?doc=253484&id=253485

Delay applying mineral N to a crop that has already had slurry applied

Since many types of manure contain as much or more crop-available phosphate than N, manure application rates are often limited to match the crop's requirement for phosphate. The remaining requirement for N is then supplied through fertiliser. However, applying N fertiliser and slurry at the same time increases emissions of nitrous oxide. If you separate the applications of the two materials by a few days it should reduce emissions.

Maintain soil pH at suitable levels for crop/grass production

Information from surveys such as the Representative Soil Sampling Scheme indicates that about 35% of UK agricultural land is below optimum pH and requires liming. Keeping pH at an optimum level for crop growth has the potential to reduce nitrous oxide emissions because it assists in the efficient use of N fertiliser. The fertiliser Manual (RB209) includes guidance on liming - https://www.gov.uk/fertiliser-recommendations-for-crops

Methane

Agriculture produces about 43% of the UK's annual methane emissions. Around 85% of methane generated by the agricultural sector arises from enteric fermentation (the digestive process by microorganisms to break down carbohydrates into simple molecules for absorption into the bloodstream of an animal), mainly by ruminant livestock, with the remainder from manure. Production of methane in the rumen is influenced by many factors, including milk yield (for lactating stock), type and quality and quantity of feed, digestibility of the ration, forage/concentrate ratio, temperature, body weight, age, amount of exercise and the methane conversion rate of the feed. Methane losses from the rumen are equivalent to between 2% and 14% of gross energy intake (GEI), with a typical average loss of around 6%.

Methane emissions are an inevitable by-product of production but efficiency measures can be adopted. Good management of livestock is key to reducing enteric emissions, with measures such as dietary manipulation proven to give a 10% reduction.

A good example of how more efficient use of inputs can reduce GHG emissions is provided by the US dairy industry. In 2007, the same amount of milk (around 1 billion litres) was produced as in 1944. This was achieved with only 21% of the animal population, 23% of the feedstuffs, 35% of the water and 10% of the land. Over that period, methane emissions per litre of milk were reduced by 57% and nitrous oxide emissions by 44%. These efficiencies were achieved through a combination of improved animal health, animal breeding, better feed rationing, reduced wastage housing and improved milking equipment.

Measures to reduce methane emissions

Livestock breeding

The amount of methane emitted per unit of feed intake varies between animals due, in part, to heritable differences in the production of methane in the rumen. Animal breeding could potentially achieve a methane reduction of between 10% and 20% from ruminants. However, such an approach might take a decade or two before we see substantial reductions in emissions.

Reduce dairy cow replacement rates

A potential measure to reduce GHG emissions from intensive dairy farming is to reduce replacement rates. This highlights the importance of a good herd health and reproductive performance.

Improving herd fertility and increasing the number of lactations per cow will improve overall business efficiency and reduce the associated methane emissions as you will carry less young stock as a proportion of your herd. Focussing on yield alone can be detrimental to overall efficiency in this respect and utilising breeding indicators such as Profitable Lifetime Index (PLI) can offer a holistic view for breeding strategy which factors in other key metrics such as fertility, health longevity, cell counts and locomotion. More information can be found through DairyCo, the levy funded organisation working for dairy farmers - http://www.dairyco.org.uk/technical-information/breeding-genetics/pli-elements/#.UpSJNMRdV4Q

The same principle applies to beef and lamb production systems. Using Estimated Breeding Values (EBV) can assist in improving overall herd and flock efficiency by helping to incorporate desirable traits. More information can be found through Signet, part of EBLEX the industry body for beef and lamb levy-payers in England - http://www.signetfbc.co.uk/beefbreeder/index.aspx?section=8&item=69

Energy consumption

Some farming systems use lots of energy and therefore the emissions of carbon dioxide can be high. Systems that have a significant requirement for heating or cooling such as glass houses, vegetable production and intensive livestock systems are energy intensive farming systems. Some field crops are also energy intensive, for example, root crops that require a lot of soil movement, irrigation (requiring energy for water application) and energy intensive harvest and transport.

The first step to reduce GHG emissions and save money is to start to monitor energy use per operation. For example, for each field operation record date, crop and operation, tractor type, driver, fuel used (if possible) or tractor hours. Careful analysis of the data will start to show differences between fields (e.g. because of soil type, or weather and soil moisture), drivers and machines. This will allow informed management that can save energy. For refrigerated stores, glasshouses and dairies, an energy audit can often pay for itself very quickly by identifying maintenance needs and energy efficiency opportunities.

Renewable energy options should also be considered, such as biomass, geothermal energy, solar and wind energy. Over time these can become an additional source of income for the farmer, allowing more independence from rising fuel costs and helping reduce GHG emissions. For more information on incentive schemes – https://www.ofgem.gov.uk/environmental-programmes/renewable-heat-incentive-rhi

Specific actions that can be taken to reduce GHG emissions

Preserve carbon sinks and stores

Some land has large stores of carbon in soil and/or vegetation (carbon stores) and on some land the carbon stored is increasing (carbon sinks). Where possible, farmers and land managers should preserve carbon sinks and stores, such as forests and other types of vegetation.

Carry out a GHG audit

To obtain an overview of the balance of GHG emissions of their business and carbon storage of their land and vegetation, land managers can use the CLA's online calculator CALM. http://www.cla.org.uk/Policy_Work/CALM_Calculator/

The Farming Advice Service offers guidance on a range of issues including Cross Compliance, nutrient management, climate change and competitiveness. We provide advice through group meetings, events and a technical helpline. If you have any further queries relating to this article or any other FAS subject areas, please contact the helpline on **0845 345 1302**. For general enquiries or to register for the FAS newsletter or free text message reminder service, please email advice@farmingadviceservice.org.uk

Website: http://www.defra.gov.uk/farming-advice/

Further information can be found from the following sources:
Carbon Trust http://www.carbontrust.com/resources/guides/sector-based-advice/agriculture-and-horticulture
Farming Futures - http://www.farmingfutures.org.uk/
Tried & Tested - http://www.nutrientmanagement.org/home/