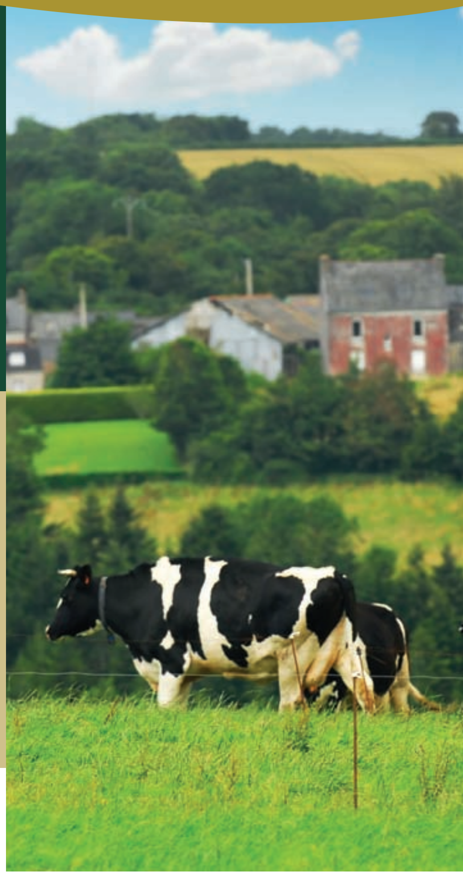
Royal Agricultural Society of England

Practice with Science

Extract 2: Reducing emissions from livestock

Greenhouse Gas Emission (GHG) from livestock has become a topic right at the heart of the climate change debate. The Royal Agricultural Society of England has commissioned this work to demonstrate that while there is a case to answer, livestock farmers and researchers supporting them are making real progress in reducing emissions, managing cattle waste and developing technologies that will enable livestock to be farmed sympathetically with the environment.



Grazed livestock are good news for the UK

Livestock production brings many benefits to the UK food chain, the landscape and the environment. It is an important contributor to the drive for sustainable food security now promoted by Defra; but also presents undeniable environmental challenges.

Production efficiency has increased steadily over the past 30 years, dramatically reducing the environmental footprint of UK livestock farming. For the industry to continue to support the balanced diet that we need and to stay competitive in the face of climate change, increasing global population and limited resources, that trend must continue.

Producers must adapt to a changing world by putting the best science into practice. Not only will that allow farmers to exploit opportunities brought by climate change and global demand, it will also reduce the environmental impact of livestock production.

Grassland farmers can make a considerable contribution to food security while continuing to reduce their environmental impact.

More than 60% of British agricultural land is grassland and much of it, particularly the hills and uplands, is unsuitable for other crops. Semi-permanent rough grazing and improved grasslands play an important role in locking up carbon dioxide and regulating the flow of rain into water courses. Without livestock farming, those natural resources would be abandoned and the landscape would soon change beyond recognition.

There is a public perception, encouraged by some interest groups, that livestock farming is the major source of greenhouse gas (GHG) emission in the UK. There have even been calls to stop eating meat and dairy products in order to reduce livestock numbers. This is a gross exaggeration that must be met with a robust challenge and corrected.

The facts

- For every Kg of product that enters the food chain, UK farming has reduced its carbon footprint over the past 30 years and will continue to do so by steadily increasing production efficiency.
- Scientific development in feed formulation, improved animal genetics and changes in forage production could, if promoted and encouraged, continue to reduce the amount of GHGs released.
- Emissions can be better managed, both in storage and in how waste is applied to land or used in energy production through anaerobic digestion, to further minimise GHG escape.

GREENHOUSE GAS EMISSIONS

Agriculture generates around 38% of UK methane emissions, equivalent to 2.9% of the total global warming potential from all UK GHG emissions, while nitrous oxide emissions from agriculture, including both livestock and crop production, account for around 4% of the total UK global warming potential from GHGs.

On the positive side, carbon sequestration by grassland is significant and can capture around 380 Mt CO2e across Europe each year. While GHG emissions from livestock production are inevitable, they have declined by 17% since 1990 due to lower livestock numbers. Emissions from agricultural soils have also fallen as agricultural practice has moved to synthetic, rather than organic, fertiliser.

Lower livestock numbers have not reduced output thanks to increased efficiency from improved genetics. The key measure is not the emissions generated by each animal but the carbon footprint of each unit of final product.

A dairy cow producing 8,000 litres of milk a year produces less methane than two 4,000 litre/year cows, because maintenance of each cow produces methane over and above that needed for milk production.

Breeding for efficiency in the pig and poultry industries has greatly improved feed conversion, with more nutrients converted into meat and eggs and less lost to the environment. Slower genetic improvement in beef cattle and sheep is reflected in lower decreases in their carbon footprints.

Livestock farming is expected to continue to reduce its environmental footprint with GHG emissions from each tonne of product reducing 0.8 – 1.2% each year as genetic selection is applied in the pig, poultry and dairy sectors.

However, such change needs to be cost effective and recognised by the UK inventory for GHG emissions, managed by the IPCC (Intergovernmental Panel on Climate Change), if the UK is to meet its target for GHG reduction. The main areas that contribute to the inventory are reduced animal numbers, more efficient animals as well as improved management and use of manures and fertilisers.

This has informed the following proposals, some already used by progressive farmers; others needing further research to develop new management practices, requiring agricultural supply companies to develop improved equipment or new strains of breeding stock.

Table1. Percentage reduction in methane and nitrous oxide emissions per tonne of product from genetic improvement between 1988 and 2007

Kg GHG/t of product	Methane	Nitrous oxide	GWP100 (Global warming potential)
Layers	30	29	25
Broilers	20	23	23
Turkeys	0	0	0
Pigs	17	14	15
Dairy	25	30	16
Beef	0	0	0
Sheep	1	0	1

Genesis Faraday 2007a

REDUCED ANIMAL NUMBERS

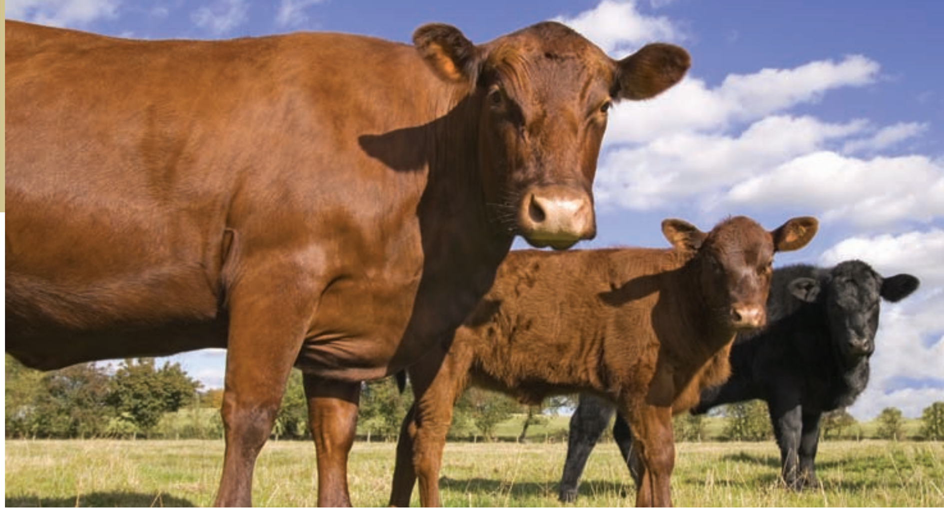
A reduction in demand would lead to fewer animals. However, both industry and Government are looking to at least maintain output to meet food needs. The most cost effective approach is to make every animal more productive. Future policy objectives can include:

INCREASED YIELD FROM EACH ANIMAL

Studies on the Langhill Herd in Edinburgh showed that, even allowing for additional yield that higher quality diets bring, improvement in the genotype of the cows generated increased milk yield. Similar improvements have been recorded for growth rates and carcase conformation in pigs, poultry, beef cattle and sheep with subsequent increases in meat yield. In addition, recent research has focused on genetic selection criteria that include welfare traits to avoid undesirable characteristics being selected along with increased yield potential. Genetic selection using Sire Referencing Schemes, chromosomal markers, and selection indices could be expanded to include terms that bring a reduced environmental footprint. While this may slow the rate of genetic gain for yield and other criteria, it should improve cost of production as more of the costs associated with feed are translated into saleable product.

REDUCE BREEDING STOCK NUMBERS

Improvement in reproductive performance of breeding stock will reduce the numbers of animals needed to generate production animals. For instance, sheep selection programmes have increased lambing index and introducing a fertility gene from Meishan pigs into Large White pig lines boosted litter size. The recent introduction of fertility traits into the selection index should increase the working life of dairy cows, thereby reducing the number of replacement heifers required. A study from Nottingham University in 2004 showed that if fertility in dairy cows returned to its level in 1995, enteric methane emissions from the national herd would fall by 11%.



REDUCE WASTAGE OF PRODUCT THAT DOESN'T MEET MARKET SPECIFICATION

Carcases that are rejected for not meeting customer specifications either require extra, expensive processing or are wasted completely. The clearest example of this is the large numbers of hill sheep that lose value due to carcase size, muscle depth or fat content. Male lambs from the hills have limited value now that live exports have been reduced. This waste can be reduced by improving carcase quality of those male lambs by genetic selection using high quality sires identified with computer-aided X-ray tomography (CT scanning), crossing with other breeds that have a better conformation, or by selection within the breed using chromosomal markers.

IMPROVE ANIMAL SURVIVAL

The number of animals that die at birth or before maturity is unacceptably high, and requires replacements to meet market needs. A heritable component has been identified in perinatal mortality so better survival can be genetically selected. Also improved disease resistance will reduce the numbers of animals that die or are culled before they mature and enter their productive state.

IMPROVE FEED CONVERSION

Feed accounts for a significant proportion of rearing costs for the food market. While the biology of digestion and metabolism means that significant amounts of nutrients are lost in gaseous emissions, urine and faeces, there are significant differences between species and management practices.

INCREASE NUTRIENT CAPTURE EFFICIENCY

Progress in pigs and poultry has been made easier because daily live weight gain is recorded on very large numbers and related back to genetic lineage. It is more difficult with extensive sheep and beef enterprises, making improvements in feed conversion efficiency considerably slower. New technologies are being developed for analysing the genetic fingerprints of animals using SNP (Single Nucleotide Polymorphism) arrays, known as genome-wide selection. This will become an important tool for the livestock breeder.

OPTIMISE THE LEVEL OF FEED THE ANIMAL EATS

Most animals eat more than they need for growth and wellbeing. Selection of stock that consume only what is needed for optimum production will reduce pollution from excess nutrients. This has been achieved to a great extent in modern pig and poultry lines but there are opportunities to introduce it into ruminants. Australian researchers are taking forward this concept, known as residual feed intake and have demonstrated that there is a heritable component that can be selected.

IMPROVE THE NUTRIENT BALANCE IN LIVESTOCK RATIONS

Better ration formulation to balance nutrients with real demand can result in more efficient use of nutrients and lower cost of production. The most recent update on livestock rationing in the UK was the reformulation of dairy cow rations in the Feed-into-Milk programme, now adopted by all major feed companies.

High levels of fibre in dairy and beef rations can promote methane production. Reducing fibre while increasing starch levels can promote improved performance and lower methane per tonne of product. This can be achieved by reducing grass and forage in the ration and increasing cereal-based concentrates. This can increase milk production by 14% and reduce methane by 7% .

DEVELOP IMPROVED FORAGE CROPS

New forage crops are being developed as part of ration reformulation to better balance nutrients. Examples include using lupin meal as a high quality protein source for cattle and sheep, and naked oats for poultry rations. If the current extensive use of GM crops around the world can demonstrate no unforeseen deleterious consequences, then UK livestock farmers will increasingly have access to new developments to improve nutritional quality in forage crops.

INCLUDE RATION COMPONENTS THAT REDUCE METHANE AND AMMONIA EMISSIONS

Methane and ammonia are produced by the rumen microflora using hydrogen produced by other microbes during forage degradation. Increasing the availability of fermentable carbohydrate in dairy cattle feed, such as developing grass varieties with higher sugar content, both promotes higher milk yields and reduces urinary nitrogen excretion. Other examples include forages with tannins, eg clover, chicory and lotus, and polyphenol oxidase eg red clover varieties.

MANAGING EMISSIONS FROM LIVESTOCK FARMS

All the above measures will reduce emissions from livestock farming but there will always be some pollutants produced. These need to be managed to restrict their access to the environment.

MANAGE MANURE

Liquid handling systems using covered slurry storage and switching to aerobic storage can help. Future solutions for housed livestock could include scrubbing effluent air from production units to reduce gaseous emissions to the atmosphere and capturing methane as an energy source. New Zealand researchers have developed nitrification inhibitors for application to land. These reduce the conversion of soil-retained ammonium to nitrate, so reducing leaching.

USE MANURES AS A RESOURCE

Equipment has been developed to allow precision application of manures based on nutrient content and crop requirements while the uncertainty of oil prices make purchased fertilisers less cost-effective. The faster slurry can be incorporated into soil, the lower the nitrous oxide emissions, so injection is preferable to spreading.

Anaerobic digestion (AD) is an attractive energy source but difficulty in planning permissions and high installation costs can make it unattractive. For on-farm AD, electricity generation has been estimated to be 35% efficient, with 20% of total output being used to operate the digester. Excess heat generated by AD is available for use on farm.

If the UK is to meet its newly set targets for reducing GHG emissions by 2050 then regulators need to stimulate investment in anaerobic digesters.

CONCLUSIONS

Grazed livestock make a key contribution to UK food security and the management of landscape and environment. The sector faces a number of challenges, for which science will provide many of the answers. UK agricultural science has a world class reputation and has led the way in production efficiency over recent years. Continuing support for scientific research is essential if the UK is to meet the challenges facing global food production in the 21st century.

The author

Dr David Garwes is an independent consultant specialising in livestock science. His current roles include: an R&D Manager for DairyCo; Chairman/member, Advisory Group for Scottish Government Research WP2, Livestock; Member, Sustainable Livestock Production LINK Programme Management Committee; and Livestock Science programme adviser for Defra, and other national organisations within the UK livestock farming sector.

David has a lifetime's experience in both the research and commercial sectors dealing with animal health and production.

The full article prepared by Dr David Garwes will be included in the next RASE Journal and will appear on the RASE website.

Royal Agricultural Society of England
Stoneleigh Park, Warwickshire, CV8 2LZ
www.rase.org.uk RASE Charity no. 209961

Contact Joanna Righton; joannar@rase.org.uk; 024 76 858254