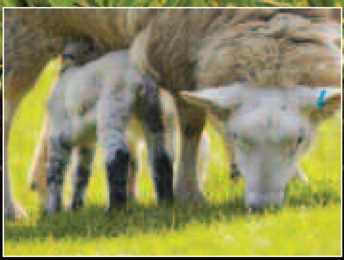
EBLEX



down to earth

The beef and sheep roadmap - phase three

AHDB Agriculture & Horticulture Development Board

Acknowledgements

The EBLEX roadmap project work is a collaborative effort, this time including a number of retailers, as well as research establishments and commercial enterprises. EBLEX would like to thank them for their support with this report.

In addition, the ongoing support of Defra, industry bodies and trade associations is vital to the climate change work.

EBLEX would like to thank those who have contributed images to this publication, including Peter Dean. No images may be reproduced without prior permission.

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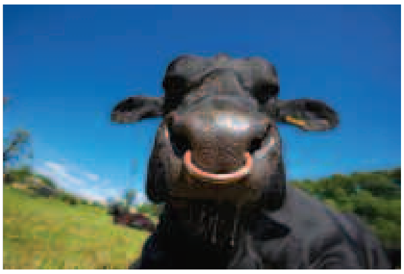



The Greenhouse Gas Action Plan

The Greenhouse Gas Action Plan (GHGAP) sets out how the agriculture industry in England is responding to the challenge of producing more while reducing the emissions impact. It is a commitment by a number of industry groups, including AHDB — of which EBLEX is the beef and sheep division — working together to reduce our greenhouse gas (GHG) emissions by three million tonnes of CO_2 equivalents per year from 2018 to 2022.

The plan, which can be viewed at www.ahdb.org.uk, includes a number of objectives and actions. Our roadmap work is a part of the overall project and contributes towards the plan. We have included notifications throughout this document where a specific activity links directly to a section within the GHGAP. On each occasion, the GHGAP logo will be included alongside the topic heading along with a summary of the area it relates to.

Chairman's introduction

When the beef and sheep roadmap project was launched in 2008, our aims were to deliver a better understanding of the environmental challenges facing the industry and develop practical ways to reduce the carbon footprint of the sector. Nearly four years on and I am very proud with what we have achieved in providing benchmarking data, stimulating debate and informing our knowledge transfer work via the Better Returns Programme.

This third chapter adds to the work in the first two and together they should be viewed as a single cohesive roadmap, examining a broad range of issues connected to the overall carbon hoofprint of the industry. This includes not only the direct contribution of emissions from livestock but also energy and water use, economic returns, landscape and biodiversity value and waste in the supply chain.

Here we include for the first time significant input from retailers, detailing measures they are taking to reduce emissions in their supply chain, complementing the on-farm actions already investigated in the roadmap programme. It also introduces data from our most recent on-farm carbon survey and looks at carbon sequestration as a mitigating factor in livestock farming. Finally, it updates targets established in the earlier publications, helping to construct a picture of progress so far - and I am pleased to see progress made towards achieving the 2020 industry targets.

Climate change remains one of the biggest challenges for the beef and sheep meat sector and I believe by benchmarking performance and identifying practical ways to reduce the sector's environmental impact, we are sending an important message and demonstrating clear leadership.

The key to success is to maximise farm efficiency, whatever the enterprise type. The common challenge for any producer is to find the right balance of enterprise system and management techniques to maximise the output for food production, while minimising impact on the environment and ensuring profitability for their business. With a rising world population and ever increasing pressure on our natural resources, this remains a global challenge and not one we can solve on our own.

As acknowledged in the Greenhouse Gas Action Plan, sector roadmaps, such as this one and those produced by other AHDB divisions, are important vehicles for changing farm practices to improve production efficiency.

We remain as committed as ever to research that highlights the key drivers to efficiency and delivers practical measures that can help producers, processors and all others in the beef and sheep meat supply chain reduce our environmental impact.

John Cross
EBLEX Chairman

The story so far

The UK Government and the beef and sheep industry are committed to reducing the environmental impact of the sector, particularly GHG emissions. Under the Climate Change Act 2008, the UK Government is legally required to achieve an overall reduction of 80% in GHGs from 1990 levels by 2050 across the UK economy. Agriculture will have to play its part in this, with the immediate target of an 11% reduction in annual emissions by 2020. This can be achieved through more efficient use of fertiliser and better management of livestock and manure.

In addition, the UK Greenhouse Gas Action Plan (GHGAP) sets out how the industry is responding to the challenge. It shows our commitment to reducing our greenhouse gas emissions by three million tonnes of CO_2 equivalents per year from 2018 to 2022.

There are around 9.9 million head of cattle in England, with 21.3 million sheep (Defra census March 2011). All produce methane as a by-product of rumination. Nitrous oxide and carbon dioxide are generated indirectly from raising beef cattle and sheep. Together, these gases make up the greenhouse gas cost attributed to livestock production, measured in CO_2 equivalents as the common measurement currency comparable to other sectors and industries.

In 2010, there were 2.1 million head of cattle slaughtered, 57 per cent from the dairy herd and 43 per cent from the beef herd, worth more than £2.3 billion. The equivalent figures for the sheep sector are 14 million slaughterings in 2010, with a value of £991 million.

Work completed in the first two chapters of the EBLEX roadmap project - Change in the Air, published in November 2009, and Testing the Water, in December 2010 - showed that the best opportunities to reduce GHG emissions from these animals was through improved breeding, feeding and management. Changes in all of these areas individually showed that the targets set above were technically achievable.

In terms of a benchmark, the Lifecycle Analysis (LCA) research, based on a theoretical model, carried out for beef cattle and sheep by Cranfield University and published in Change in the Air, suggested the average carbon footprint for beef production in England was 13.9kg CO_2 eq per kilogram of beef produced. For sheep it was 14.6kg CO_2 eq per kilogram of meat produced.

In Testing the Water, a different model was employed - the E-CO_2 system, certified by the Carbon Trust. These results, using real data from 30 beef and 30 sheep farms, showed an average emissions footprint for cattle of 11.93kg CO_2 eq and 11.95kg CO_2 eq for sheep per kilogram liveweight. While these figures differ from the LCA calculations in the first year's roadmap work, they reflect a real-world assessment. The range of values resulting from a relatively small data set are in line with the LCA values from phase one and generally follow the trends for system types (eg lowland suckler beef, upland suckler beef, dairy beef, hill flocks, upland flocks and lowland flocks).

The on-farm carbon audit work has been used to inform EBLEX's ongoing Better Returns Programme knowledge transfer activity, suggesting practical ways individual farmers can enhance practices to reduce their environmental footprint and, as a result, help steer the industry towards the aforementioned targets.

Executive summary

On-farm

The carbon data collected in 2011 shows broadly the same trends as those in 2010 but employs a larger data set, adding further credence to the figures. There is little or no change to the averages year-on-year and the range of results remains similar.

In total, 131 English Beef and 57 English Sheep enterprises were surveyed to gather data for this document. This compares to 30 beef and 30 sheep data sets in 2010.

Across all beef units studied, the E-CO_2 carbon calculator showed an average 100-year Global Warming Potential (GWP100) of 12.65kg CO_2 eq/kg liveweight.

The equivalent figure for sheep across 57 units studied was 11.86kg CO_2 eq/kg liveweight.

Case studies of farms included have helped identify traits that typify low carbon and high carbon farms. These include:

Low carbon farm

- Achieving optimum daily liveweight gains
- Achieving the best finishing weight as early as possible
- Feeding good quality grass or a high quality ration (with high available metabolisable energy - ME) where required and the use of co-products where suitable
- High output per breeding unit.

High carbon farm

- Below average liveweight gain
- Light weight at slaughter
- High feed rate per kilogram of meat produced
- Low output per breeding unit.

Carbon sequestration

Despite some conflicting evidence, data does suggest that effective management of grassland areas, including using grazing animals, does maximise an area's efficiency as a carbon sink. It is possible to identify broad activities to help this but more research is needed in this area to specifically quantify these benefits as mitigation against the emissions impact of grazing livestock.

Waste in the supply chain

More than 90 per cent of the total emissions footprint for beef and lamb to point of sale is accounted for on-farm. This illustrates that tackling on-farm emissions is the most effective way to make carbon savings to the level required by the Greenhouse Gas Action Plan and the Climate Change Act 2008. The most important action of the post-farm gate supply chain is to minimise waste of animal products in which the majority of the carbon cost is already embedded.

Retailers

Six multiple retailers contributed to the EBLEX roadmap work in 2011. These were Asda, M&S, Morrison's, Sainsbury's, Tesco and Waitrose. All are conscious of the savings in terms of environmental impact that can be achieved by working with their beef and lamb supply chains.

Across all six, a range of innovative schemes exist to help achieve this, including working directly with farmers.

Action plan update

Six performance monitoring indicators were established by EBLEX in 2008 and published for the first time in the 2009 roadmap. In the latest updates, the beef sector shows some positive trends towards the 2020 target.

Ewe fertility and lamb carcase weights have dropped slightly over the past two seasons, reflecting the impact seasonal weather variations can have on the sheep sector in particular - the more extensive nature of sheep production making it more vulnerable. This also emphasises the need to adopt a long-term view when assessing industry trends.

In all other areas, progress has been made towards the targets.

The emissions performance of English beef and sheep meat enterprises

EBLEX commissioned the E-CO_2 Project's model for appraisal of beef and sheep carbon footprints, certified by the Carbon Trust. The model uses Carbon Trust, Intergovernmental Panel on Climate Change 2006 and PAS 2050 methodology to calculate the carbon footprint or global warming potential (GWP) of beef and sheep meat production.

The E-CO_2 Project carbon footprint system analyses a farm enterprise from 'cradle to farm gate'. Any emissions past the farm gate are picked up by the meat processor, including transport to the abattoir. No allowances are made for any meat co-products or the '5th quarter' in the calculations. In terms of the LCA methodology, it means that this is part of the abattoir's carbon footprint. (Additional information on the methodology and carbon credits associated with it is included in the appendix.)

In total, 65 English beef and 57 English sheep enterprise data sets were analysed for this report for EBLEX. This data was significantly enhanced by partner-working with McDonald's, who allowed us to add their own data from 66 English beef enterprises, giving a total of 131 beef units, to study. This enhances our confidence of the early assumptions drawn from the smaller survey carried out in 2010 by E-CO_2, which were published in the previous roadmap, allowing for a more accurate picture of emissions in the sector, although we accept this continues to be work in progress.

The overall observation is that the average CO_2 production numbers for enterprise types are similar to our 2010 data and show the same trends.

Beef enterprises

Across all 131 beef units studied, the E-CO_2 carbon calculator shows an average 100-year Global Warming Potential (GWP100) of 12.65kg CO_2 eq/kg liveweight. This figure is very similar to the overall average of our 2010 survey of 11.93 kg CO_2 eq/kg liveweight. See Table 1.

Table 1: Overall average of English beef production

Beef farms (131 units in total)	kg CO_2 eq/kg lw	kg CO_2 eq/kg dw
Average	12.65	23.43
Lowest	3.02	5.59
Highest	29.70	55.0

NB: A 54% killing out value is applied for deadweight

For this report, we have divided the 131 data sets into enterprise types which match our annual Business Pointers costings survey. See Table 2 for the overall summary.

Table 2: English beef production system footprints

	Environmental impact (GWP100)		
System type	**Average beef (kg CO_2 eq/kg lw)**	**Average stores figure (kg CO_2 eq/kg lw)**	**Range (kg CO_2 eq/kg lw)**
Dairy beef (38 farms)	8.64	-	3.02 - 15.11
Finisher (16 farms)	10.48	-	6.97 - 18.92
Rearer finisher (53 farms)	15.24	-	6.18 - 29.70
Total finisher units (107)	**12.19**	**-**	**3.02 - 29.70**
Lowland store producer (14 farms)	-	15.68	8.70 - 29.26
Upland store producer (10 farms)	-	13.39	5.50 - 18.91
Total Store producer units (24 farms)	**-**	**14.73**	**5.50 - 29.26**

NB: includes data sets kindly supplied by McDonald's

Finishing farms

Among the finishing units, the results show that dairy beef production has a lower CO_2 output, which is largely due to the majority of the cost of the breeding cow being captured by the milk output in the dairy enterprise. Dedicated beef finishing enterprises generally have a lower CO_2 output for the same reason, as the store producing breeding cow picks up some of the CO_2 emission "cost". The overall average for farms finishing beef is 12.19 kg CO_2 eq/kg liveweight (Table 3).

Table 3: Beef finishing production footprint

	Environmental Impact (GWP100)	
Beef farms (107 units selling finished animals)	**kg CO_2 eq/kg liveweight**	**kg CO_2 eq/kg deadweight**
Average	12.19	22.57
Lowest	3.02	5.59
Highest	29.70	55.0

NB: A 54% killing out value is applied for deadweight

Store producing units

For the first time, we have separated out the average figures for farms producing store cattle. With just 24 farms, it is one of the smaller data sets (see Table 4). When split into LFA and non-LFA farms, the figures follow the trend seen in 2010 where LFA units out-performed non-LFA units.

Table 4: Beef store producer production footprint

	Environmental Impact (GWP100)	
Store farms (24 store producers)	**kg CO_2 eq/kg liveweight**	**Range (kg CO_2 eq/kg lw)**
Average	14.73	-
Lowest	5.50	-
Highest	29.26	-
Non LFA store producer (14 farms)	15.68	8.70 - 29.26
LFA store producer (10 farms)	13.39	5.50 -18.91

We can see that store production showed a higher footprint than finishing beef units, with most of the difference likely to be due to the carbon cost of keeping the suckler cow. In line with our 2010 data, we found that lowland beef production has a slightly higher CO_2 cost and the widest range of figures. We suggest this reflects the different land use types in lowland beef production, which often include poorer land and extensive systems especially where the beef unit is a secondary enterprise on a mixed farm and so may not be given as much focus as the primary enterprise. The seemingly more efficient production in upland suckler beef units reflects a similar picture found in our annual Business Pointers survey which shows greater individual cow output in these upland units.

Summary

The range of values/performance mirrors the data collected in 2010, illustrating that there are huge gains to be made by encouraging better use of available resources to bring those with the highest carbon footprint to a level closer to those in the lower range. Simply by analysing the practices of the best performers and effectively communicating these, offers huge opportunities for improvement.

The type of system employed by an individual farmer can impact upon their overall carbon footprint. However, the data illustrates that for each system there are those who perform very well and others who fall significantly shorter in terms of efficiency. This leads to the conclusion that the enterprise type is not necessarily a main driver of carbon efficiency.

Overall, the survey has identified that there is a wide range in the level of GHG emissions across beef systems in England. This highlights the beneficial impact of combining the efficient use of resources with management techniques to deliver the greatest efficiency from an enterprise. It represents a win-win opportunity where greater efficiency and improved returns also deliver a lower carbon footprint and less potential impact on overall climate change.

Sheep producers

Across all 57 sheep units studied, the E-CO_2 carbon calculator shows an average 100-year Global Warming Potential (GWP100) of 11.86kg CO_2 eq/kg liveweight. This average figure is almost identical to the 2010 data set of 11.95kg CO_2 eq/kg liveweight (see Table 5), when just 30 sheep units were analysed.

Table 5: Overall English sheep production footprint

	Environmental Impact (GWP100)	
Sheep farms (57 units selling finished animals)	**kg CO_2 eq/kg liveweight**	**kg CO_2 eq/kg deadweight**
Average	11.86	25.23
Lowest	6.43	13.68
Highest	19.71	41.94

NB: A 47% killing out value is applied for deadweight

As with the beef data, the range of values/performance mirrors that from the previous survey, illustrating that there are huge gains to be made by simply encouraging those with the highest carbon footprint to improve resource management to a level closer to those in the lower range.

The sheep enterprise data is split into four category types based on their Less Favoured Area (LFA) designation and system type (Table 6).

Table 6: English sheep production footprints

	Environmental Impact (GWP100)		
System type	**Average sheep (kg CO_2 eq/kg liveweight)**	**Average stores figure (kg CO_2 eq/kg liveweight)**	**Range (kg CO_2 eq/kg liveweight)**
Lowland (31 farms)	10.98	-	6.43 - 17.78
Upland (11 farms)	10.86	-	8.33 - 15.35
Hill Farm (15 farms)	14.42	-	8.42 - 19.71
Stores (4 farms)	-	12.78	9.34 - 15.72

It is likely the higher figure for hill farms represents the more extensive nature of hill sheep production which utilises generally poorer vegetation and forage and, as a consequence, is associated with lower production. Many of these areas could not sustain another form of food production and while their footprint might be slightly higher, the wider benefits to landscape management and biodiversity need to be considered beyond the simple comparison of GHG emissions.

The slightly higher average figure for farms within the Less Favoured Areas (LFAs - upland and hill farms) should not be the focus of our attention. Instead, we should identify the factors common to those farms whose carbon footprint is better for the system type and encourage less-well-performing enterprises to adopt similar practices, where possible. Having more farms producing at the lower end of the CO_2 range will help drive a substantial reduction in the industry's overall GHG production. To this end, EBLEX activity through its Better Returns Programme, which has a membership of 21,000 beef and sheep farmers, is helping to drive change.

Practical ways to reduce carbon production

Analysis of the data sets allows us to make certain generalisations about practices or typical characteristics of high and low carbon farms for both beef and sheep enterprises. These points can facilitate practical, on-farm changes in business practices to reduce their carbon footprint.

Low carbon farm:

- Achieving optimum daily liveweight gains
- Achieving the animal's optimal finishing weight as early as possible
- Feeding a high quality ration (high Metabolisable Energy (ME) density) and the use of co-products, where possible
- Reducing the reliance on artificial fertiliser
- Low carbon source of protein (such as rapeseed meal rather than soyabean meal).

High carbon farm:

- Below average live weight gain
- Light carcase weight/liveweight at slaughter
- High feed rate per kilogram of meat produced
- Heavy reliance on artificial fertiliser
- A high slaughter age given the inputs and resources used.

In order to reduce GHG emissions, producers should examine the key performance indicators for their systems and compare them to other producers to identify areas where improvements can be made. EBLEX publishes its Business Pointers annually which provides industry average financial and performance figures on which to make some basic comparisons. As demonstrated in the previous chapter of the roadmap, Testing the Water, there is a correlation between good environmental performance and good economic performance.

Farmer carbon footprint case studies

Key GHGAP Activities, section 20f

To illustrate some of the practical points suggested above, four of the farmers surveyed for the E-CO_2 Project gave a greater insight into their farm results and the types of system they employ. They also illustrate the link, as documented in Testing the Water, between environmental efficiency and financial margins.

Low carbon beef contribute to farm profit

Farmer: Jim and Sarah Broadwith

Farm: Red House Farm, Bedale, North Yorkshire

Enterprise: Specialist dairy beef producer

Carbon footprint 2011: 9.10kg CO_2 eq/kg of beef produced liveweight (range for dairy beef producers in 2011 = 3.02 - 15.11)

The cattle enterprise on James and Sarah Broadwith's mixed farm in the Vale of York has grown rapidly since it was established 10 years ago and is now an integral part of the business.

The 350 dairy-bred Aberdeen Angus animals are finished on the farm, arriving at four months of age in late winter/early spring. They spend the summer grazing rented pasture, before being housed to finish on a forage-based ration after 14 months on farm. The calves are bought and sold on contract through Dovecote Park and the beef is retailed through Waitrose.

"The cattle fit well into our farming system," explains Mr Broadwith. "They supply manure for the arable crops and are out grazing during peak arable workload. From a profitability point of view, the cattle also buffer the effects of volatile grain and potato prices, which is very important to us.

"As calves are ordered months in advance, we need to achieve daily liveweight gains of between 0.9 and 1kg/day consistently, to make sure there is room for the next batch to come in. Steers finish at 580kg liveweight, with heifers at 530kg."

The ration is tweaked on a day-to-day basis and cattle weight gains regularly monitored.

Just two tractors work across the enterprises. A new feeder wagon has recently replaced a smaller, less efficient one, the aim being to reduce the labour, diesel and tractor costs of feeding cattle. This will help bring down farm fuel emissions.

In most other areas, however, GHG emissions are well below average on this farm. Feed use emissions are particularly low due to the varied diet which uses rapemeal rather than high carbon soya and brewer's grains. Farm fertiliser emissions are also low as regular soil testing shows phosphate and potash levels to be adequate for grass growth and little nitrogen fertiliser is applied.

"We aim to maximise profit and efficiency across the whole farm, not just the cattle and we are always looking for ways to improve," says Mr Broadwith. "The fact that this has delivered a low carbon footprint is an incidental benefit which we are really pleased about."

Keys to low carbon score:

- Drive for efficiency
- Lower carbon feeds
- Animals fit the system
- Little bought-in fertiliser.

Striving for highest returns at lowest cost

Farmer: Angus Stovold

Farm: Lydling Farm, Godalming, Surrey

Enterprise: Pedigree Aberdeen Angus Breeder

Carbon footprint 2011: 11.02kg CO_2 eq/kg of beef produced liveweight (range for rearer finishers in 2011 = 6.18 - 29.70)

The light sandy land at Lydling Farm is too hungry to sustain good cereal crops without large amounts of expensive inputs, so the decision was made some years ago to stop arable farming and to expand the existing cattle enterprise, better suited to the natural resources of the farm. Now the award-winning Rosemead Aberdeen Angus herd produces 70 bulls for sale each year and 30 high quality breeding females.

Angus Stovold capitalises on the breed's capacity to thrive on a low-cost, forage-based system. The cows calve in two batches at two years of age, which maximises their lifetime output of calves. They are never housed and out-winter on chalk-based corrals, which reduce housing and associated costs.

Only the young bulls are fed concentrates to ensure high growth rates (1.4kg/day) so they meet target weights for sale at 18 months of age. This is reflected in a very low carbon score for farm feed use emissions.

"We farm environmentally and our cattle are integral to the system," explains Mr Stovold. "We need them to graze the pasture to encourage plant diversity and maintain sward quality. But their dung also encourages dung beetles which feed the bats and so on."

White clover has been introduced into some of the more productive leys to provide insurance against drought years when grass growth can falter on the dry soils.

Lucerne and red clover are also grown for their drought tolerance, high protein levels and nitrogen fixing ability. Farmyard manure from the youngstock is spread on land destined for maize grown for silage. No inorganic fertiliser is applied.

Other input costs are closely monitored and scrutinised. Soils are regularly tested to ensure pH, phosphate and potash levels are right for grass growth. The maize is only sprayed when necessary and worm burdens are measured before any cattle are treated with anthelmintics.

"Essentially, economics drive our business," says Mr Stovold. "We would be very much worse off today financially, if we hadn't changed from intensive arable to cattle all those years ago.

"By playing to our strengths, we maximise our profit by producing high quality, productive breeding stock as cost effectively as possible, enhancing the environment at the same time.

Key points to a low carbon score:

- High growth rates for bulls
- Calving at two years old
- Tight cost control
- No inorganic fertiliser.

Simplicity is the key to an efficient sheep enterprise

Farmer: Adam Quinney

Farm: Reins Farm, Redditch, Worcestershire

Enterprise: Lowland Finished lamb production

Carbon footprint 2011: 8.6kg CO_2 eq/kg of lamb produced liveweight (average all lowland lamb producers audited in 2011 = 10.98)

Simplicity is the key to Adam Quinney's sheep enterprise on his 224ha farm in the West Midlands.

The 200 Lleyn ewes run alongside 100 suckler cows with maize and wheat also grown for home-consumption. The sheep system is designed to fit the resources available and to be highly productive with minimal inputs.

The ewes winter on grass and lamb outdoors in April. Only ewes carrying triplets receive some additional hard feed. After lambing, the sheep are offered clean pasture, previously grazed by the cattle, until weaning in August. Lambs are then fattened on red clover/grass leys.

"Red clover has transformed our system," says Mr Quinney. "All the lambs finish-off it with no added concentrates. They grow at an average 0.34kg/day, easily reaching 22kg deadweight by the first draw at the beginning of October, when 80% are sent away. When we first introduced red clover, finished weights rose by 2kg a lamb."

The flock is closed and topped up with home-bred replacements. These are selected from healthy, fit ewes that have proved themselves as independent lambers and good mothers.

Ewe lambs are put to the tup, increasing their lifetime output and spreading their total greenhouse emissions over more kg of meat produced.

One and a half finished lambs are sold per ewe each year, including ewe lambs.

The grassland derives all its nutrients from white and red clover and manure from the cattle enterprise, so emissions from bought-in fertilisers are zero.

Grass leys are re-seeded every six to seven years. New high sugar ryegrasses are being introduced to boost lamb growth rates. These also reduce the carbon footprint as the protein in these varieties can be used more efficiently by the animals, so less is excreted.

With such a simple system, cost control is relatively easy and no money is spent unnecessarily. The lambs only need worming once, vet and sundry inputs are low and feet are trimmed once a year. Buying a two-wheeled drive bike has halved diesel consumption.

"This system works and the margins we make per lamb are excellent," says Mr Quinney.

Keys to low carbon score:

- Focus on forage
- White and red clover
- High production per ewe
- Fast growth rates.

Recording keeps carbon losses down

Farmer: Duncan Nelless

Farm: Thistleyhaugh, Northumberland

Enterprise: Upland Store and finished lamb producer

Carbon footprint 2011: 8.3kg CO_2 eq/kg of lamb produced liveweight (range for upland lamb producers assessed in 2011 = 8.33 - 15.35)

Lamb growth rates at Thistleyhaugh Farm, owned by the Nelless family, have risen dramatically over the past five years, increasing for the finishing lambs from 0.22kg/day in 2007 up to 0.26kg/day in 2010.

The 1,415 Lleyn flock shares the 382ha farm with 105 suckler cows, 2,700 outdoor pigs reared on contract and a free range poultry enterprise producing table birds.

One of the main reasons for the leap in growth rates has been the use of electronic identification to record the performance of every ewe and lamb born. This has helped select the right replacement ewes, as the best and worst animals are easily identified.

"In five years we have gathered a huge amount of information which we could never have done manually," explains Duncan Nelless who manages the sheep enterprise. "The payback from the investment in kit and labour has been phenomenal. We would not have made the genetic progress we have, in terms of growth rates and maternal ability, without EID.

"Our target is for ewes to wean a weight of lamb equivalent to their pre-tupping weight, as this shows they are efficient producers and can look after their lambs well.

"Last year the ewes reared an average of 66.7kg of lamb (liveweight) each. We feel this is a more useful measure of physical efficiency than scanning figures.

We are not looking for triplets; rather maximum meat output per ewe."

Some of the most forward ewe lambs are put to the tup. This increases their contribution to the bottom line, while reducing their lifetime carbon footprint.

The farm completed organic conversion in 2007. The restrictions on using artificial fertiliser help lower the farm's carbon footprint, but also focus Mr Nelless' mind on the inputs he can use.

Integrating the sheep grazing with the cattle keeps down worm burdens so the sheep only need worming once per year, no feed is purchased and machinery is kept to a minimum.

Red and white clover leys provide all the feed for the sheep. Lambs are finished on red clover silage aftermaths. Ewes overwinter on tightly-managed deferred grazing shut up at the end of August.

"Organic farming still has to be managed to achieve efficient production per hectare and this is our key driver," says Mr Nelless. "Happily, this also brings down our carbon footprint."

Keys to low carbon score

- Performance recording
- Animal efficiency targets
- No use of artificial fertilisers
- Well-managed grazing forages.

Soil carbon sequestration

"Agriculture and other land management practices have a positive role to play in climate change mitigation because there is significant potential to remove CO_2 from the atmosphere by the process of photosynthesis and storage as living biomass (vegetation) or as soil organic matter (carbon sequestration)."

In the ongoing debate about livestock production and its contribution to GHG emissions, storage of carbon in pastures and other grassland areas effectively managed by grazing beef cattle or sheep has often been cited as a mitigating factor. It is well documented that ruminants expel GHGs but there is less concrete analysis of the benefits they bring in managing areas of grassland that act as a carbon sink, actively taking carbon dioxide out of the atmosphere and storing it so it does not contribute to GHG levels. This could be a significant mitigating factor for livestock farming.

Commercial carbon footprinting services are now available to calculate individual farm carbon footprints on a unit of product basis. In most cases, these commercial services follow the Carbon Trust and BSI PAS 2050 Carbon Footprinting standard, introduced in 2008, which the E-CO_2 model used by EBLEX adheres to. However, it is important to recognise that the carbon footprinting methodology described within PAS2050 does not currently take account of soil carbon sequestration due to a lack of comparable evidence in this area. Currently, more extensive production systems, often based on unimproved permanent pasture, have high carbon footprints, yet the farmland often has high stocks of soil carbon. While, the carbon in this system may be in equilibrium and therefore the soil may not continue to sequester carbon, grazing the land does avoid shrub invasion and reduces the risk of wildfires which result in massive carbon dioxide release into the atmosphere.

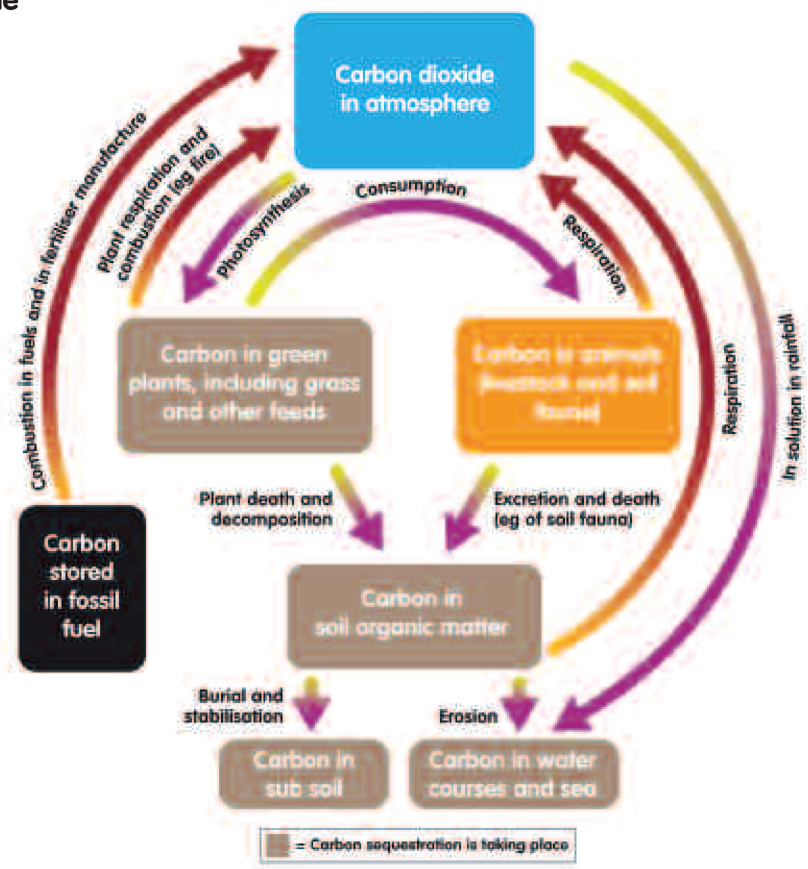
The importance of soil structure and nutrient levels has long been recognised in relation to the productivity of agricultural land. Soil organic matter in particular is known to be related to water holding capacity, nutrient retention, reduced erosion and soil workability. But it is soil carbon storage - or sequestration - that needs greater exploration.

Carbon sequestration is the process by which carbon dioxide from the atmosphere is absorbed and stored as biomass by trees, foliage and roots, and in soils. Plants absorb carbon dioxide during photosynthesis to form carbohydrates, they also return carbon dioxide to the atmosphere via respiration. Forests, farmland and natural ecosystems then become carbon 'sinks' because they store carbon in amounts that exceed the carbon they release over a specified time period.

This means that soil management to remove carbon dioxide from the atmosphere through soil carbon sequestration could be increasingly important.

However, it is important to realise that such soil sinks may not be permanent. Soil can act as a carbon sink for as much as 50 parts per million (PPM) of atmospheric CO_2 for 100 to 150 years. Once sequestered, carbon is likely to remain in the soil for as long as the management practices are maintained, for instance until grazing land is ploughed up for planting crops. It is then released. Thus, change of land use from grazed pasture to cropping may have a significant negative impact on the carbon footprint of that enterprise.

The carbon cycle



Implementing livestock and grazing management to improve soil organic matter formation with the associated soil carbon sequestration is an essential aim of good livestock practice. Many farmers are now switched on to the benefits of improving soil quality to deliver greater production through better performing swards, utilisation of nutrients, water retention and higher stocking rates, etc.

In a broader UK environmental context, the role of soils, semi-natural habitats and grasslands to deliver ecosystem services, including organic matter storage and GHG sequestration, has been given prominence with the production of the UK's National Ecosystem Assessment, launched in June 2011, and has highlighted the role of farmland and agriculturally utilised semi-natural habitats in delivering environmental goods.

Management effects on soil carbon

There is conflicting evidence about recent changes in soil organic matter content. Table 7 presents some recently published trends. On the one hand, there appears to be relatively stable and, in some cases, increased soil organic carbon in grasslands, particularly permanent grasslands and semi-natural grazed habitats. On the other hand, in arable land there are greater concerns about reductions of soil organic carbon and a need for management to address this.

Table 7: Changes in C density (0-15 cm) in England by Countryside Survey Broad Habitat types

	Mean C density (t/ha)		
Broad habitat class	**1978**	**1998**	**2007**
Improved grassland	62.9	68.5	64.6
Neutral grassland	62.4	65.6	65.9
Acid grassland	76.6	72.0	95.5
Arable land	49.1	49.8	46.9
All habitats inc bog/ heath/woodland	69.6	71.5	70.2

Source: Emmet et al. (2010)

Similarly, evidence regarding effects of different management regimes can be contradictory. However, it is possible to highlight good practice that can help maintain soil organic carbon (SOC), as well as those practices that are likely to have a detrimental effect. These measures can inform choices for farmers looking at practices on their farms. There is general agreement about the effects of the activities listed below:

Activities likely to lead to increased SOC

On permanent grassland:

- Maintaining the sward without reseeding; using over-sowing techniques/minimal cultivation (rather than full cultivation) if there is a perceived need to introduce new seeds
- Encouraging greater contributions of legumes, eg clovers, in the sward
- Avoiding overgrazing and compaction of the soil
- Avoiding heavy (more than 50m^3/ha) doses of slurry.

On grassland leys:

- Aiming to maintain long leys rather than short-term leys or move towards permanent swards
- Including deeper rooting grass species, eg cocksfoot, fescues and legumes, eg red clover and lucerne, in seed mixtures
- Incorporating any organic materials during cultivations (particularly if there is no arable land that would take higher priority)
- Protecting surfaces on slopes: soil on slopes is particularly vulnerable to loss of organic matter by water erosion on bare surfaces and open swards.

Within the farm generally:

- Planting of trees, hedges, thickets especially on uncropped areas; windbreaks on exposed sites, especially on arable land, can help reduce wind erosion.

Activities likely to lead to reduced SOC

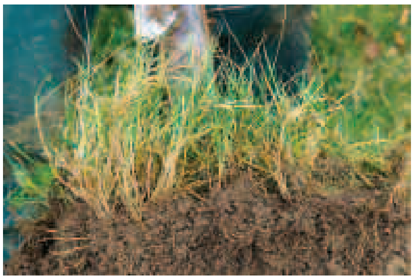
On arable land and grassland leys

- Frequent ploughing, especially on soils that are high in soil organic matter
- Leaving areas of bare ground that are at risk of losing soil organic matter by wind or water erosion
- Not adding organic manures
- Soil compaction due to machinery and livestock
- Burning of residues.

On grassland generally

- Very high inputs of fertilisers (as this increases the ratio of above-ground growth to that of root)
- Overgrazing. This can lead to poaching and bare areas, reduced root growth, soil erosion and compaction
- Poaching generally should be avoided (eg through inappropriate grazing in wet conditions, even at low stocking densities)
- Burning, eg wildfires on moorlands.

GHG Emissions Inventory



At a national level, UK GHG emissions are currently reported within the UK National Atmospheric Emissions Inventory. Within this inventory there are currently two categories that relate to agriculture: 'Agriculture' and 'Land Use, Land Use Change and Forestry' (LULUCF). Within the agriculture category, only nitrous oxide and methane emissions from soils, livestock and livestock manures are counted. These emissions are reported within the boundary of the farm gate, so do not reflect embedded or downstream emissions. The Agriculture Inventory also does not include carbon emissions from fuel use and land use change, as these are reported under separate inventories for Energy and LULUCF, respectively.

The LULUCF sector in the greenhouse gas inventory reports carbon stock changes and greenhouse gas emissions from land use change and specific land management activities. Soil carbon stock changes due to land use management (rather than land use change) are currently under-represented in the LULUCF inventory.

Although currently separate, in the future there are plans to integrate these two sections of the Greenhouse Gas Inventory into one AFOLU sector (Agriculture, Forestry and Other Land Use) to better reflect both the mitigation potential of agriculture and forestry as well as its emissions. However, this will not happen until the end of the first Kyoto protocol commitment period and so will not be implemented until 2015 at the earliest.

There is also work underway to improve the estimation of emissions and carbon fluxes within the agriculture industry to reflect more accurately management changes on farm which might reduce net GHG emissions. For example, the Agricultural Greenhouse Gas Platform is a partnership of 16 organisations which aim to produce a revised set of methane and nitrous oxide emission factors for a range of agricultural systems and identify suitable sources of farm practice data to improve our reporting (see www.ghgplatform.org.uk).

Despite current initiatives, more work is required to develop a robust evidence base to underpin the development of policies, support measures and advice to farmers to protect and increase levels of soil carbon and reduce GHG emissions.

Beyond the farm gate

Objectives, section 5, ciii

While the first half of this third EBLEX environmental report has focused on farm, it is important to recognise the contribution that the whole supply chain can make to bring down the overall emission costs for beef and sheep meat. This extends to the retailers of the final product and their own supply chain and distribution network. Again, this information informs the wider debate and brings significant amounts of information together in one place to help identify where efficiencies can be made. As such, it forms an important part of the beef and sheep roadmap project and demonstrates the ongoing partnership working between suppliers, processors and retailers of beef and sheep meat in England.

Environmental impact through the supply chain

The contributions of the retail distribution system to greenhouse gas emissions and energy use for beef and lamb have been estimated by Cranfield University using the principles of LCA. A Defra/Scottish Government LINK project with partners throughout the supply chain aimed at understanding ways of reducing waste of beef and lamb is also nearing completion.

The assessment is built on previous Cranfield Life Cycle Analyses of beef and lamb with recently available data on slaughtering, processing and packaging (Whitehead et al, 2011) and retail distribution and stores (Tassou et al, 2008). This is then used to estimate the GHG emissions and energy use for beef and lamb through to retail sale.

The analysis shows that on-farm activity dominates emissions and energy use for beef and lamb to the point of retail sale. More than 90% of emissions are accounted for on farm. The proportion of energy use which is on farm is lower, with 10-15% of the energy use in the whole chain being embedded in the packaging. Energy use in store also makes an important contribution to the supply chain energy use as shown in Table 6.

Table 6. Environmental analysis for beef and lamb per kg meat sold (without accounting for waste)

	GHGE (kg CO_2 eq/kg deadweight)		Energy (MJ/kg)	
	Beef	**Lamb**	**Beef**	**Lamb**
Farm to retail distribution centre	18.7	17.8	49.2	34.4
Delivery to and activities in retail store	0.7	0.7	4.3	4.3
Total	**19.5**	**18.5**	**53.5**	**38.7**

Source: Cranfield LCA analysis. Please note, the figures in the table are based on a theoretical model and reflect emissions for the whole chain to retail distribution.

Because the GHG emissions are dominated by the on-farm production, the biggest impact that the post-farm gate supply chain can have in reducing overall GHG emissions is to reduce the wastage of meat from those animals produced.

Waste at retail distribution centres and in stores is being measured in the LINK project described below but preliminary estimates suggest that this will result in increases in both energy and GHGs by less than 4 per cent for lamb and less than 3 per cent for beef.

While this analysis stopped at the retail store, WRAP (Quested and Johnson, 2009) has estimated the loss of 87,000 tonnes of avoidable waste of beef and lamb (including unidentifiable/mixed meat /offal) in the home. Given the high proportion of emissions and energy use "embedded" in the meat, it is obviously important to minimise the waste both in retail distribution and in the home.

[1] University of Bristol, Sealed Air Ltd, ASDA Stores Ltd, EBLEX, Anglo Beef Processors, Hybu Cig Cymru-Meat Promotion Wales, Quality Meat Scotland

The main aim of the LINK project "Reducing waste in beef and lamb supply chains" is to show how a better understanding of the oxidative changes which occur in beef and lamb muscles between production and retailing can be controlled to increase shelf life and reduce food waste. Estimates of current meat wastage and plastics use, and possible savings from adopting new technologies, will be evaluated under six sub-objectives:

1. Calculate the amount of waste generated at different stages in typical beef and lamb supply chains from packaging to point of sale at retail

2. Determine the optimum gas to meat volumes for Modified Atmosphere (MA) packs in terms of colour, shelf life, lipid and protein oxidation and investigate the use of gas mixtures with lower concentrations of oxygen

3. Examine the alternatives to MA packs for beef and lamb cuts. It will contrast MA, vacuum skin packaging (VSP) and VSP-Bloom systems in terms of colour, lipid oxidation, protein oxidation and toughness

4. Determine the effects of processing variables such as muscle pH/temperature and ageing time on colour, lipid and protein oxidation. The role of muscle vitamin E in these situations will be determined and a mechanism for high oxygen-induced toughening/reduced tenderisation provided

5. Investigate the effects of dietary vitamin E and selenium on the shelf life characteristics of lamb including colour, lipid oxidation and protein oxidation

6. Disseminate results of the research to the meat industry.

The results from this work have not yet been published but will deliver practical advice for the reduction of waste and energy use in the post-farm gate supply chain. It is clear that a joint industry approach is essential to overall success in reducing emissions in the beef and sheep meat supply chain after the farm gate.

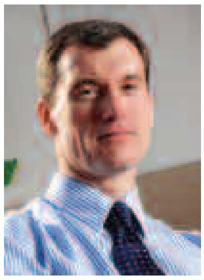
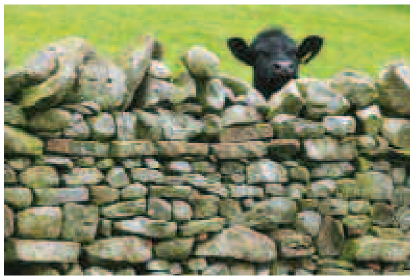
Retailers at work

greenhouse gas action plan

Key GHGAP Activities, Action 4

The previous section of this report gave an overarching view of where the emissions burden lies in the beef and lamb supply chain and what can be done to address this going forward by looking at the issue of waste. However, all of the main multiple retailers in England have their own projects looking to reduce the carbon footprint of their beef and lamb supply chains. In this area, the industry is again working together to seek out efficiencies.

As part of the work for this roadmap, EBLEX invited each of the main retailers to outline examples of work they are undertaking to help identify best practice and ensure joined-up working to ultimately reduce our environmental impact.

Dr Chris Brown, Head of Ethical and Sustainable Sourcing, ASDA

Asda is committed to helping its farmer suppliers cut carbon emissions and improve their environmental footprint, particularly in livestock production and is working with farmers to achieve both of these goals.

One major way they're doing this is to encourage the use of high sugar grasses by farmers in their BeefLink, DairyLink and LambLink producer groups. Asda is aiming to reduce the CO_2 from its farmers' cows and sheep and cut emissions by 186,000 tonnes. This would be the equivalent of 78,000 cars being taken off the road.

To achieve this aim, we have teamed up with British Seed Houses to introduce Aber® High Sugar Grass (Aber HSG) and Aber clovers to its 13,500 farmers across the UK.

Not only will the use of high sugar grasses improve the environmental impact of livestock farming, it will also help reduce bought-in feed costs and improve production efficiencies and meat and milk yields.

Alongside this pioneering work, Asda has also led the field in helping beef farmers make use of better genetics, by encouraging use of high EBV bulls through artificial insemination (AI).

By achieving significant discounts on semen prices (up to 75%), Asda has enabled its farmers to tap into some of the best bulls available at commercial prices.

On top of that, Asda has been working with Yorkshire producer Mike Powley to adapt heat detection technology usually used in the dairy sector to enable him to spot heat in suckler cows at grass. Mr Powley has been the first UK suckler farmer to use Heattime as a heat detection aid in a commercial suckler herd to aid AI timing.

Accurate heat detection means Mr Powley has been able to use sexed female and male semen effectively and to best advantage in producing bull beef for the Asda heavy beef scheme which accepts E and U grade carcases up to 550kg.

Steve McLean, Agricultural Manager, M&S

Marks & Spencer's 'Farming for the Future' programme covers a range of activity designed to safeguard our supply chain, reduce cost and help our supply partners and the wider farming community adapt to the challenges ahead. Within the beef and lamb sector, this activity is specifically targeted at helping producers to improve technical efficiency and sustainability.

We are in regular dialogue with the beef and sheep farmers within our supply base, including regular regional farmer meetings and farm visits. These are used to share best practice, identify issues and build mutual understanding.

In addition, we have a producer website, which is regularly updated with case studies, technical information sheets and news. This has a specific section for the beef and sheep sectors. We also publish a regular newsletter, which is sent to all farmers and growers in our supply base.

Working with SAC, we have established our own sustainability roadmap for the beef and sheep sectors and this is being rolled out to all farmers in our supply base. This provides farmers with a series of practical tools to identify areas of their farm business that could be improved, helping them to increase profitability and reduce the farm's impact on the environment.

To support this we have created a number of indicator farms in each sector to act as a showcase for best practice and to help drive knowledge transfer. A range of sustainability indicators have also been developed, which are now included within our codes of practice.

We recognise that the industry needs to develop more knowledge in key areas to ensure that it can meet the challenges ahead. As a result, we are funding a range of research in areas as diverse as grassland management and breeding and will share the results with our supply base.

Alice Swift, Agriculture Technologist Beef, Lamb & Dairy, Sainsbury's

Sainsbury's is proactively working with producers across several species groups, including dairy, beef, lamb, pork, egg and chicken, to build sustainable food supply which is fit for the future both financially and environmentally.

The Sainsbury's Carbon Footprint Initiative began in 2007 with dairy production and, through its profound success on farm, has since expanded across all protein sectors. Species-specific carbon footprint models have been developed and accredited by the Carbon Trust to the highest tier to monitor, review and improve carbon footprints of producers. As such, the study is the largest and most robust of its kind across the globe.

The models encompass all systems and practices of production, assessing energy efficiency and use, inputs, outputs and animal health. The data collection runs over a minimum of three years with annual on-farm assessments conducted by trained assessors. With this level of longevity, key trends can be identified and the effects of uncontrollable elements, including weather, can be taken into consideration. The proceeding data analysis then builds a truly representative review of the relationship between agriculture and greenhouse gas emissions.

The results, specific to each individual farmer, and the benchmarking undertaken allow for business efficiency to be analysed and areas of weakness addressed. This then allows farmers to better understand the interaction of their farming practice on the environment and their bottom line and look to make the most effective use of resources, ensure sustainable profits and long-term business viability for generations to come.

The Sainsbury's Agricultural team meets regularly with farmers to provide support and ensure standards of welfare and sustainability are upheld and practicable.

The scale, longevity and support from Sainsbury's towards this initiative is testament to their commitment to farmers and ensuring sustainable food supply.

TESCO

Sheelagh Johnson, Beef Technical Manager and Agriculture Champion, Tesco

Corporate responsibility at Tesco is about creating a sustainable core for a successful growth business. This is underpinned by the five pillars of our corporate responsibility strategy:

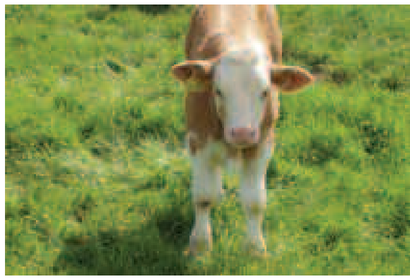
- Buying and selling our products responsibly
- Caring for the environment
- Actively supporting local communities
- Providing customers with healthy choices
- Creating good jobs and careers.

While currently not doing anything specifically on sustainability in red meat, Tesco is involved in many projects and initiatives which have an indirect positive sustainability impact.

Grassland management and younger animals: as part of our quality and efficiency drive, emphasis is being put on encouraging farmers to maximise the yield they get from their grass both in terms of end product "fit for purpose" and efficiency. Well-managed pasture of the right composition will deliver benefits to the farmer in reduced costs through lower use of hard feed and fertilisers. There should also be less need to trim at the processors as the animal is better suited to consumer requirements. Younger animals use fewer resources to achieve the desired end product while delivering the right end quality. All these will have a positive sustainability benefit.

Packaging: Tesco has had an active packaging reduction programme for many years and this is continuing with the additional aim of identifying packaging formats which are customer- focused but also allow longer shelf life, improved quality, reduced wastage and a higher units per outer count, giving more efficient transport. Many formats are currently available but all have drawbacks in one or more areas. Tesco is confident that a format which delivers the above criteria and, in addition, delivers improved sustainability will be developed.

Carcase utilisation and factory efficiency: Tesco is actively encouraging its supply base to be inventive in carcase utilisation and factory efficiencies to maximise returns while delivering customer-focused products. This covers areas from 5th quarter usage to resource usage minimisation, all of which will have sustainability, as well as efficiency benefits.

Louise Welsh, Agriculture Manager, Morrisons

Morrisons' close relationship with our beef and sheep farmer suppliers - we buy direct from around 3,000 livestock producers - means we are well placed to help this sector identify and make the kind of changes at farm level that can help the wider industry reduce its GHG emissions.

We recognise there are a number of carbon reduction initiatives underway already and we have been careful to progress activity that can complement rather than replicate.

Our own 1,000 acre beef and sheep farm at Dumfries House, in Ayrshire, Scotland, is a vital resource for us to plan and deliver practical carbon reduction projects. We have been clear from the outset that any lessons we learn on helping build farm sustainability will be shared with our fellow farmers.

First steps first though and, like any other farmer, we have had to calculate our own carbon footprint before making plans to reduce.

Now that we are able to benchmark effectively, projects in a number of areas are in progress, including a major improvement of estate grassland and soils and examination of feed conversion rates in both species. Smaller projects are underway to cut our electricity and fossil fuel consumption and we hope to be able to share meaningful results by 2013.

Building on our work on GHG reduction with our dairy farmers, we are looking at ways to extend some of the activities to the beef and sheep industry. One such project would be the application of the Morrisons Carbon Reduction Barometer. We aim to offer this tool to our farmers who have yet to measure their footprint. Once they have done this, we can then work with them to identify ways that they can reduce GHG emissions and boost profitability at the same time. We are also updating our Renewable Energy report in 2012 to include technologies that are applicable to red meat businesses.

Waitrose

Duncan Sinclair, Agriculture Manager, Waitrose

Over the last two years, a programme of activity has been undertaken in conjunction with key industry experts and partners to raise awareness of the challenges of climate change. The approach has focused on a series of knowledge exchange events which have been run for our beef and lamb supply chains to encourage the adoption of best practice. The core themes addressed have included the issues of soil health, grassland utilisation and grazing strategies, new grass and clover varieties, and raising awareness of alternative protein crops such as lucerne and chicory. A total of 16 events have been undertaken thus far with a further programme of events being planned for 2012 and beyond.

Waitrose has also provided seed funding for the establishment of the Centre of Excellence for UK Agriculture, a joint initiative between Aberystwyth University and NIAB TAG. The CEUKF is developing a knowledge hub focusing on Sustainable Efficient Production in Farming and Food Supply.

A commercial trial has been undertaken by a group of more than 40 lamb suppliers to evaluate the benefits of using high EBV rams in their flocks. This confirmed the offspring of the high EBV rams had faster growth rates, improved conformation and reduced days to slaughter than their counterparts from the farm's non-recorded rams.

Emissions action plan update

greenhouse gas action plan

Monitoring Progress, section 30

When the first chapter of the beef and sheep roadmap was published in late 2009, EBLEX identified some key performance indicators for the industry. The following table updates the figures to give a an illustration of progress to date.

Component	Action	Output	2008	2009	2010	2020 target
Beef efficiency Carcase gain (kg/day)	Undertaking an annual assessment of the weight of carcase produced per day of age across English beef production bringing together BCMS age at slaughter data and carcase weights from MLCSL carcase classification reports.	An annual benchmark for the efficiency of beef output that can be tracked forward (and back) to provide the industry and producers with information on progress and targets against which to assess individual performance.	0.448	0.452	0.456	0.484
Beef fertility Calving interval (days)	Undertaking an annual assessment of calving interval in the English beef herd from BCMS data.	An annual benchmark for beef herd fertility that can be tracked forward (and back) to provide the industry and producers with information on progress and targets against which to assess individual performance.	442	446	440	420
Beef herd output Calves per 100 cows calving per year	Undertaking an annual assessment of calves produced per cow calving per year from BCMS data.	An annual benchmark for beef herd fertility and management that can be tracked forward (and back) to provide the industry and producers with information on progress and targets against which to assess individual performance.	84.88	84.30	85.08	87

Component	Action	Output	2008	2009	2010	2020 target
Age at first calving Age (months)	Undertaking an annual assessment of age at first calving of beef bred females in England.	An annual benchmark for beef herd fertility and management that can be tracked forward (and back) to provide the industry and producers with information on progress and targets against which to assess individual performance.	33.7	34.0	33.6	32.0
Cow output (Calves per cow per year of life)	Undertaking an annual assessment of calf output per year of life of beef bred females in England.	An annual benchmark for beef herd productivity that can be tracked forward (and back) to provide the industry and producers with information on progress and targets against which to assess individual performance.	0.59	0.61	0.62	0.63
Lamb efficiency Lamb carcase weight produced per ewe (kg)	Undertaking an annual assessment of the weight of lamb carcase produced per ewe per year from Defra census data and MLCSL carcase classification summary reports.	An annual benchmark for lamb production efficiency that can be tracked forward (and back) to provide the industry and producers with information on progress and targets against which to assess individual performance.	22.60	22.20	22.10	23.50

Component	Action	Output	2008	2009	2010	2020 target
Ewe fertility Number of lambs per 100 breeding female	Undertaking an annual assessment of ewe litter size from Defra census data and an AHDB model.	An annual benchmark for lamb fertility that can be tracked forward (and back) to provide the industry and producers with information on progress and targets against which to assess individual performance.	131	129	129	139
Beef and sheep unit performance Business Pointers surveys	Extending the current costings scheme to include more herds and flocks for each production system to secure more accurate data on key aspects of physical performance.	Better benchmarks of more detailed performance measures across the range of production systems to track industry progress and provide targets for individual business performance assessment.	284 beef 205 sheep	297 beef 188 sheep	286 beef 198 sheep	300 210
Beef and sheep breeding progress	Undertaking an annual evaluation of key sire and maternal estimated breeding values (EBVs) for some major beef and sheep breeds.	An annual benchmark of the progress being made by beef and sheep breeders to track progress and highlight the potential for performance.	5-year average to 2008 Suffolk 0.082 pts/yr Texel 6.80 pts/yr Limousin 0.742 BV/yr	5-year average to 2009 Suffolk 0.096 pts/yr Texel 5.39 pts/yr Limousin 0.710 BV/yr	5-year average to 2010 Suffolk 0.112 pts/yr Texel 7.00 pts/yr Limousin 0.896 BV/yr	5-year average to 2020 Suffolk 0.12 pts/yr Texel 10.0 pts/yr Limousin 1.1 BV/yr

Appendix 1

What is a carbon footprint?

A carbon footprint refers to the emission of three major greenhouse gases produced in agriculture. These are carbon dioxide (CO_2) methane (CH_4) and nitrous oxide (NO_2). CH_4 is 23 times and NO_2 is 297 times more potent than CO_2. When calculating a carbon footprint for a farm or unit, CH_4 and NO_2 are converted to carbon dioxide equivalents so that one number can be quoted in carbon dioxide equivalents - CO_2 eq.

E-CO2 carbon footprint model

EBLEX has used a commercially available model, called E-CO_2 for its 2010 and 2011 on- farm carbon audits.

- All results have been generated using The E-CO_2 Projects model which has been fully certified by the Carbon Trust
- The model uses Carbon Trust, Intergovernmental Panel on Climate Change 2006 and PAS 2050 methodology to calculate the carbon footprint or Global warming potential (GWP) of beef and sheep production
- The carbon footprint results are presented as kilograms of carbon equivalents (CO_2 eq) per kilogram of beef produced/lamb produced (live weight)
- The E-CO_2 Project carbon footprint system analyses a farm enterprise from 'cradle to farm gate'; any emissions past the farm gate are picked up by the meat processor (this includes transport to the abattoir)
- No allowances are made for any meat co-products or the '5th quarter' in the calculations. In terms of the 'lifecycle analysis' methodology, this means that this is part of the abattoir's carbon footprint
- Co-products (or by-products) have a lower carbon footprint than more conventional feeds because the carbon cost of producing such a product has been split between stock feed and its primary use. For example, brewers' grains arrive on farm with around 10% of the carbon cost associated with its production and processing. The remaining 90% has been left at its primary use and set against the beer.

Carbon sequestration

The E-CO_2 model does not allow for any carbon sequestration in the grassland of a beef or sheep enterprise. It would be difficult to accurately quantify the carbon absorption potential of the subsoil on individual farms, and the E-CO_2 model is based on the IPCC rules as mentioned above, these do not include carbon capture in their modelling for grassland.

Carbon credits

The E-CO_2 model takes into account all factors from cradle to farm gate, however, there are many other factors to be considered in terms of carbon credits.

Exporting and importing forage from a beef or sheep enterprise does have an associated carbon cost or credit. This involves a carbon cost being incurred if forage is bought into the system and a carbon credit to the enterprise if any surplus forage is sold that would otherwise have been used on your beef and sheep production. Likewise, for producers buying or selling stores, the farmer picks up or passes on emissions produced by these animals.

Culls cows or cull ewes which are sold for meat back into the human food chain must accept some of the emissions produced by the farm meat enterprise. The majority of the emissions produced over the lifetime of these cows and ewes and the inputs associated with them are allocated to their offspring. Dairy cows, as they produce many thousands of litres of milk over their lifetime, allocate a large amount of their emissions to milk and so smaller values of carbon are attached to their calves to be used for beef than would be the case in suckler herds.

Cull cows from the dairy herd have the lowest CO_2 per unit of production, as they are a co-product from the dairy industry.

On-farm fuel and electricity used by a farm's beef and sheep enterprise is recorded during the assessment which allows the associated emissions to be calculated.

Appendix 2

EBLEX research and development contributions to improving farm efficiency and reducing carbon outputs

EBLEX funds a varied R&D programme providing information to update and inform producers and the red meat supply chain. Most projects are sole-funded by EBLEX but it also co-funds some research with other levy bodies across AHDB and the other red meat levy bodies. Projects aim to improve the efficiency of red meat production and its processing chain, driving improved profitability and reduced environmental impact. For more information go to http://www.eblex.org.uk/research

Ongoing research to help further reductions in emissions

R&D Theme: More efficient animals

Project	Background	Output	Report date
Carcase trait evaluations	Estimated breeding values (EBVs) allow producers to select genetically superior animals. Currently carcase traits are based on ultrasound scans of live animals.	To investigate if carcase classification data from abattoirs can be linked to pedigree information to improve the accuracy of EBVs.	April 2012
The role of biotin in reducing lameness in sheep	Average lameness prevalence is around 10%, with the aim of reducing it to 5%. Poor hoof integrity may be a precursor for foot infections. The addition of biotin (B vitamin) may improve hoof health.	To understand if the addition of biotin to a ewe's diet reduces the prevalence of lameness at a flock level. This means that a simple bolus could improve ewe health and longevity.	Nov 2012

R&D Theme: More efficient feeding

Project	Background	Output	Report date
Chicory and beef cattle performance	Chicory is a valuable forage for sheep production but little was known about its management under cattle grazing.	To provide management guidelines for producers and to investigate if chicory helps to control internal parasites in cattle.	April 2012
Feed planning tool development	A NZ feed planning software program is being used to test the model in England with Marks & Spencer.	To have a method to help producers improve grass utilisation and minimise bought-in feed requirements.	May 2012

R&D Theme: More efficient plants

Project	Background	Output	Report date
Breeding grass and clover for improved nitrogen, phosphate and water use	In the future, the availability of nitrogen, phosphate and water may be limited. Grass needs to be able to adapt.	To produce grass and clover varieties that can survive and thrive in harsher conditions, so forage production can be maintained with different climates.	March 2013
Reduced emissions from high quality oats	Oats selected for high oil and low lignin can reduce methane emissions, plus require lower inputs than other cereal crops.	To understand how animal performance can be improved by feeding new varieties of oats and if emissions can be reduced.	August 2014
Grass and low nitrogen levels	Grass varieties are selected at high nitrogen levels, while beef and sheep producers tend to use significantly lower levels.	To understand how the yield of different grass types and varieties changes with different nitrogen regimes and with and without white clover.	December 2015

R&D Theme: More efficient meat production

Project	Background	Output	Report date
Packaging and waste	Considerable amounts of fresh beef and lamb meat are discarded before saleand in the home, because of discolouration.	To investigate methods to reduce packaging use while maintaining or improving shelf life, so both packaging and meat waste is reduced.	December 2011
5th quarter use and flow in the processing sector	The value of 5th quarter materials is increasing but little information is known on the potential scope of the production.	To provide up-to-date information on 5th quarter products, which can be used for market development and life cycle analyses.	September 2012
Alternatives to landfill for plastic waste from the processing sector	According to WRAP the meat industry uses and throws away 110,000 tonnes of packaging for a variety of reasons including inter-country and inter-plant transfers and maturation.	To investigate the alternatives to landfill for contaminated plastic packaging, for example, converting it to diesel.	September 2012

The Beef and Sheep Roadmap Project

Down to Earth is the third chapter in EBLEX's ongoing beef and sheep roadmap project. It carries on work from the previous two publications, updates data and looks at additional aspects which affect the overall environmental efficiency of the beef and sheep sector in England.

Change in the Air and Testing the Water can be downloaded from the corporate publications section of the the EBLEX website: www.eblex.org.uk

Alternatively, request hard copies by emailing admin@eblex.ahdb.org.uk

Notes

EBLEX is the organisation for beef and sheep producers in England. It exists to enhance the profitability of the sector by helping the beef and sheep supply chain to be more efficient and adding value to the industry.

Printed January 2012

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EBLEX is a division of the Agriculture and Horticulture Development Board (AHDB). Published January 2012.

Designed by the Bridge Group - www.bridge-group.co.uk