Here, in the second of a series of five articles, we take a look at how producers can improve feed efficiency to reduce GHG emissions and what this means for dairy businesses and the environment.

Feed for efficiency and reduce emissions

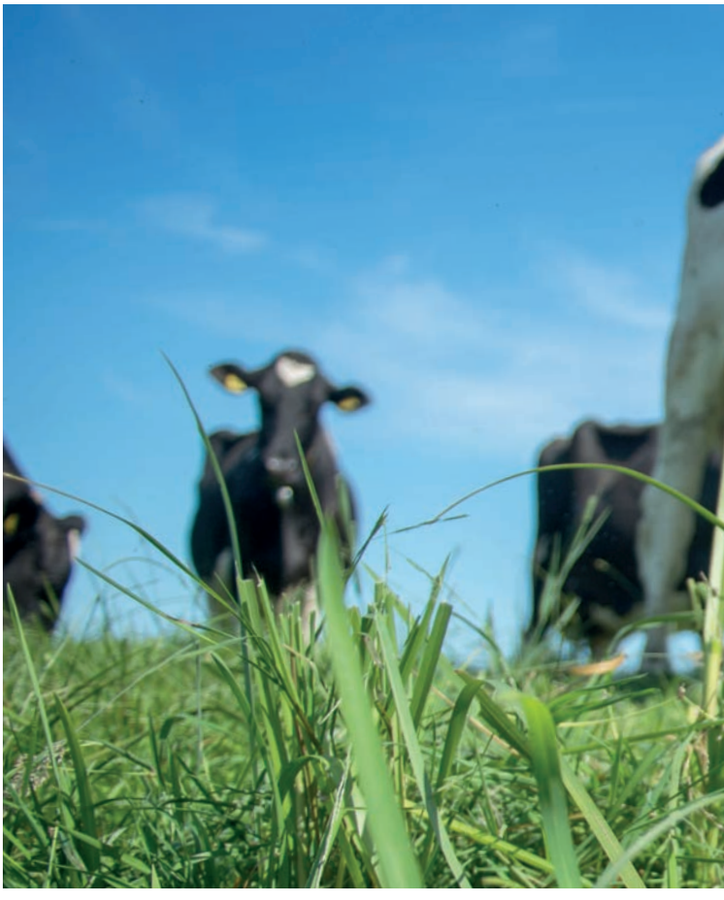
The environmental impact of dairy production and the industry's carbon footprint is under the spotlight. In the second in a series of articles, we look at how improving feed efficiency can reduce GHG emissions and, potentially, increase milk output and profitability.

TEXT RACHAEL PORTER

Focusing on feed efficiency has a key role to play in improving herd productivity and profitability. But it's also a relatively quick 'win' when it comes to reducing the greenhouse gas (GHG) and carbon footprint of UK dairy herds. The all-important 'polluters' here are methane (CH_4) and nitrous oxide (N_2O).

As producers know, methane is mostly belched out of the front end of the cow – not the back end. Pointing the finger of global warming blame at 'farting cows' is incorrect on two levels. Nitrous oxide comes from the soil from fertilisers and after deposits of nitrogen from the back end of grazing animals. The facts are, despite being blamed for more, agriculture is responsible for just 10% of the UK's GHG emissions, with livestock production responsible for half of this. This compares to 24% for the energy sector and 27% for transport.

Sweeping statements aside, reducing methane and nitrate missions is a challenge. But researcher Jon Moorby from



On-line tools to **measure CF**

Systems have been developed to make it simple and straightforward and, above all, understandable when it comes to measuring methane and nitrate emissions. Promar, Alltech E-CO_2, AB Sustain and Farm Carbon Footprint (based in the south west), all offer services to help producers carry out a CF 'lifecycle assessment'. Producers can also go on line and use the free Cool Farm tool, which is a GHG, water, and biodiversity calculator.

the Institute of Biological, Environmental and Rural Sciences (IBERS), Aberystwyth University, says that producers can tackle it at the farm level.

Feed more precisely – at grazing and housing. That was his take home message for delegates at a recent Sustainable Dairy Conference, organised by Germinal. "It's something that can be done relatively easily and with little, if any cost. And the benefits are two fold – reduced emissions and improved feed efficiency."

He says it's all about feeding the rumen – or more specifically the rumen bugs – so they are better able to convert protein in the ration that's then directed to maintenance, growth and milk production. "Efficient enteric fermentation is the aim – a good balance of protein and energy in the rumen that means that methane production and nitrogen excretion are kept to a minimum."

Decreasing emissions

Methane emissions for the UK dairy herd are decreasing, as producers focus on improving feed efficiency. Levels are down from 22 millions tonnes per year to 20 million tonnes. "But this isn't happening quickly enough and there are several reasons why this is the case," says Professor Moorby.

Methane production is linked to dry matter intakes – higher DMI typically means greater CH_4 emissions. "But high DMIs are essential to improved productivity. So our work, at Aberystwyth, has been focusing on how to maintain strong DMIs while, at the same time, reduce and minimise GHG emissions.

Key here is to manipulate – or optimise – the rumen environment so that more of the protein fed and produced

Jon Moorby:

"Efficient enteric fermentation will minimise GHG emissions"

by the rumen microbes is utilised by the cow and less is excreted – either through belching (CH_4) or faeces and urine (N_2O).

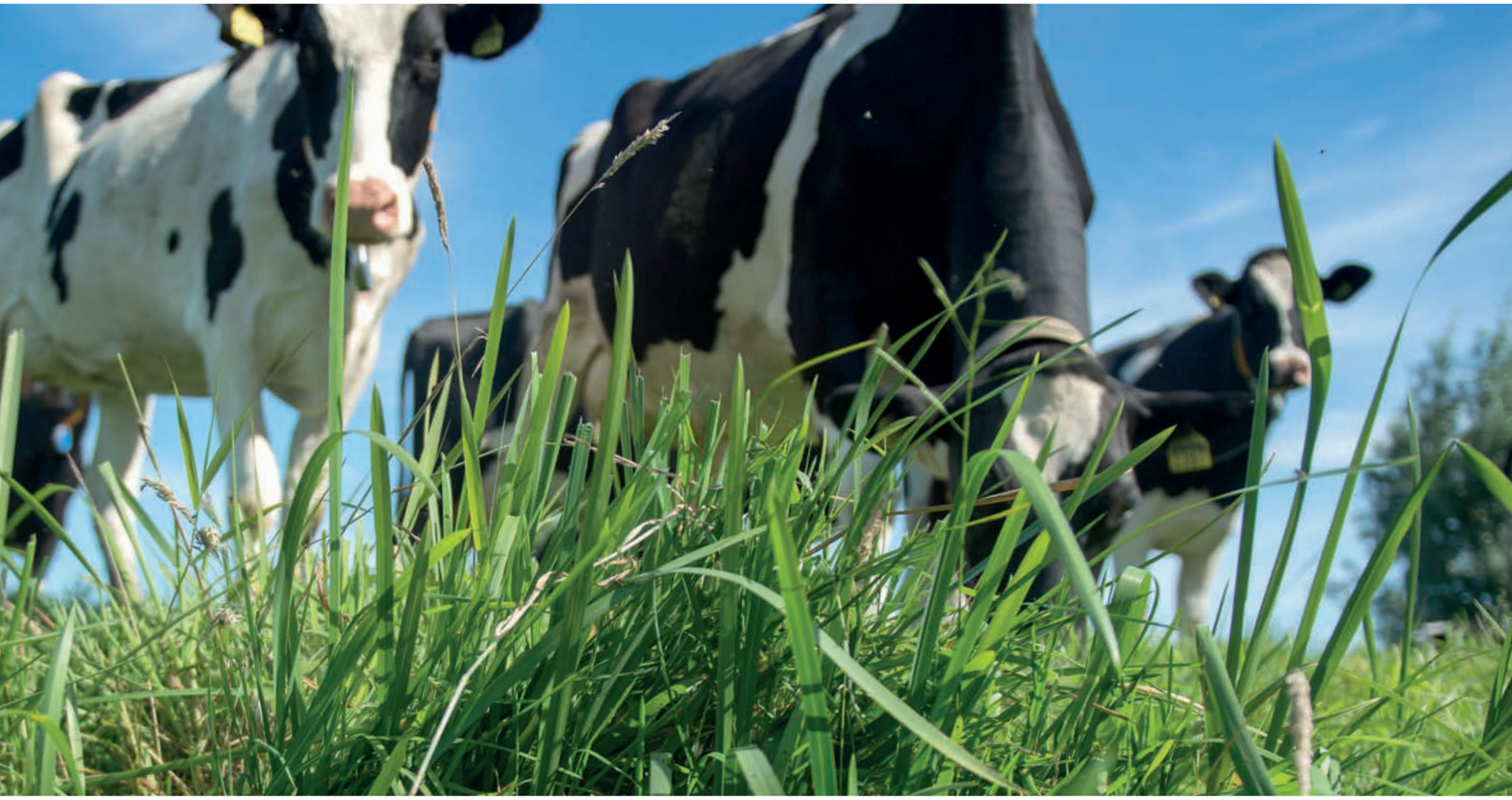
Typically around 75% of feed protein nitrogen is wasted by the cow – just 25% actually becomes milk protein. "So the challenge is to alter those percentages and help the cow to convert more nitrogen into milk," says Prof Moorby.

The good news is that cows managed on more intensive systems, where forages are more easily supplemented or balanced with ready fermentable carbohydrates, can have slightly lower methane emissions – and they are, typically, also producing more milk.

Efficient systems

"They have better feed efficiency, on the whole. And they also tend to be higher yielding. Again, milking higher yielding cows will help to reduce GHG emissions, particularly in terms of grams of CO_2 equivalents emitted per kilogramme of milk produced."

He explains that this is why, as the number of cows in the UK herd has fallen and milk production per cow has risen, there's also been a reduction in GHG emission from



dairying. "A reduction in nitrogen excretion is better for the environment, and it also results in more efficient milk production."
According to Prof Moorby, the environmental footprint of dairying systems can be reduced by 40%. And forages have a key role here. He referred to a report, written in conjunction with Bangor University's David Styles, that outlined that best pasture and manure management practices can reduce the environmental impact of dairying while increasing milk production efficiency.

More milk

Data from meta-analysis and simulation were combined to model a pasture-based dairy unit under a conventional perennial ryegrass-based scenario and a high sugar grass-based scenario. High sugar grasses, marketed globally as Aber HSG, have been bred to express elevated concentrations of water soluble carbohydrates (WSCs).
"The increased levels of water soluble carbohydrates in HSG help rumen microbes use nitrogen released from forage eaten by cows, reducing the proportion of ingested nitrogen that is lost in urine by up to 12%," says Prof Moorby.
"In return, this can reduce the amount of nitrogen potentially leached into water courses as nitrate and released as the potent greenhouse gas N_2O from soils. Cows fed Aber HSG have also been found to produce more milk than cows fed conventional ryegrasses, allowing for both production and environmental advantages."
He explains that high-sugar grasses will result in an increased proportion of nitrogen that passes through the rumen being converted to milk. "And HSGs can be fed alone or with clover. Both instances can see more milk and a reduction in nitrogen and methane losses."
He adds that some legumes have a nitrogen content that's 'almost too high' and certainly need 'balancing' with water-soluble carbohydrates, such as those available in high-sugar grass varieties.
Red clover works well here. It slows down the process of nitrogen release in the rumen. "As you increase the proportion of water soluble carbohydrates in the diet, nitrogen emissions, through the cows' urine, should fall. "It's the balance of energy and protein that's important. And grass and forage have a key role to play here. And this is great news for producers because grazed grass is the lowest cost feed available. Fresh pasture can improve milk yields and reduce nitrogen emissions."
He says that adding fats and oils to the ration can also help to reduce CH_4 production (and emissions). "But great care must be taken here to avoid overwhelming the rumen bugs. Between 5% and 7% of the diet as free oil or fat is as high as producers and nutritionists should go."
And the next thing on the horizon, which producers should look out for, are high lipid grasses. "These offer twice the energy of typical high-sugar grasses. And, again, the lipid content will help to minimise methane production in the rumen and improve feed efficiency."
Breeding also has a role to play – some cattle, even within the same breed and herd – are just better at converting protein into milk and less is wasted as methane and excreted nitrogen. |

Dairy carbon footprint facts

Dairying's key GHG emissions comprise: CO_2 (carbon dioxide), CH_4 (methane) and N_2O (nitrous oxide).
The latter persists in the atmosphere for decades and has the highest global warming potential (GWP) of the three. All three are produced and emitted by the cow through belching, urine and faeces. Other emissions from dairy, that are also the focus of reduction plans, include nitrate and ammonia. Both are produced from nitrogen excreted in faeces and urine.
Methane emissions from dairy cows are the result of belching (enteric fermentation).
Improved rumen function will reduce CH_4 emissions and improve feed conversion efficiency (FCE).
Methane emissions from enteric fermentation in cattle has decreased from 22 million tonnes in 1990 to 19 million tonnes in 2015. It is still falling.