Here, in the final article in our series, we look at how producers can improve efficiency and reduce GHG emissions through breeding and what this means for both businesses and the environment.

Genetics key to **sustainable dairying**

Breeding should be the foundation for any producer looking to reduce their herd's greenhouse gas emissions and carbon footprint. And the good news is that most, if not all, dairy cows are considerably 'greener' than they were 10 years ago.

TEXT RACHAEL PORTER

Figures show that modern breeding for more efficient, healthy and productive cows has already gone quite a way towards reducing greenhouse gas emissions from UK herds, that are declining at a rate of 1% each year through breeding. And there's more good news – faster progress could be made with a renewed focus on sire selection to reduce carbon footprint (CFP) and with relatively little effort, and with no additional cost.

"We just need a little more precision," says AHDB Dairy's Marco Winters. "What we've achieved so far, in terms of reducing the CFP of dairying through breeding, has been a side effect of simply breeding better, longer-lasting and more productive cows. Fewer cows are producing the same, if not more, milk from the same resources. Efficiency here has reduced GHG emissions."

Cow stature

One thing that producers can focus on immediately is cow size or stature. Talking to producers, they all say that they don't want to milk bigger cows – they recognise that smaller animals are more efficient to maintain. Yet this doesn't seem to translate on farm. Many cows are still tall and getting taller and heavier. Perhaps it's being missed when producers are selecting sires to use on their herds," says Mr Winters. "So I'd urge producers to be mindful of the size of their cows – and the sires they're using. And look at the maintenance index when selecting bulls too. This will help them to avoid breeding daughters with increased stature.

"I think things are still a bit 'woolly' around this. The introduction of a feed intake index will certainly help to focus minds a little better."

Work to produce a feed-efficiency index is, indeed, ongoing, with geneticist Eileen Wall and her team at SRUC. "We've a wealth of data, thanks to SRUC and NMR, and we're using this to see how we can develop a breeding index to allow producers to select for better feed conversion efficiency," says Mr Winters. The plan is to launch just such an index in 2020.

"We may call it the 'feed saved' index. We're still working on the best description, but it will help producers to improve feed efficiency and continue the downward trend in GHG emissions and dairying's carbon footprint."

Prof Wall is also working on a rumen microbiome project. "This has, so far, predominantly focused on sheep and beef cattle but we are looking at dairy cattle," she explains.

Studies are determining the difference in microbiome (the type and numbers of different bugs in the rumen) between different breeds and the effect, within breeds, that microbiome has on feed efficiency.

"We've looked at concentrate versus forage-based rations. The latter are key to good rumen function, but when fibre is broken down by rumen bugs some of the protein they produce, which goes into milk and/or meat production, is belched out as methane.

Cow size: stature and feed efficiency are all key to reducing GHG emissions

So we're looking to see how both microbiome and the ration being fed affects methane production. Ultimately, we'd like to determine the ideal microbiome to maximise feed efficiency and minimise GHG emissions."

There's potential to breed cattle that have better feed efficiency. "But there's still a lot of work to do and there are other factors to consider such as 'does the cow eat little and often or have one or two big meals a day? Is she a fast eater or does she eat slowly? And is she dominant in the herd or submissive – what's her behaviour at the feed fence?'

Feed efficiency

All these factors will also impact on rumen microbiome and pH and feed efficiency and there are others that also need to be taken into account. Other studies are looking at when the cow 'acquires' her microbiome. Is it at weaning? Is it from the environment or her dam? Or her sire? Can we 'inoculate' the calf to stimulate the growth of the ideal microbiome to maximise feed efficiency?

"So many questions and they all require thorough research to answer them. We're at the start of this journey."

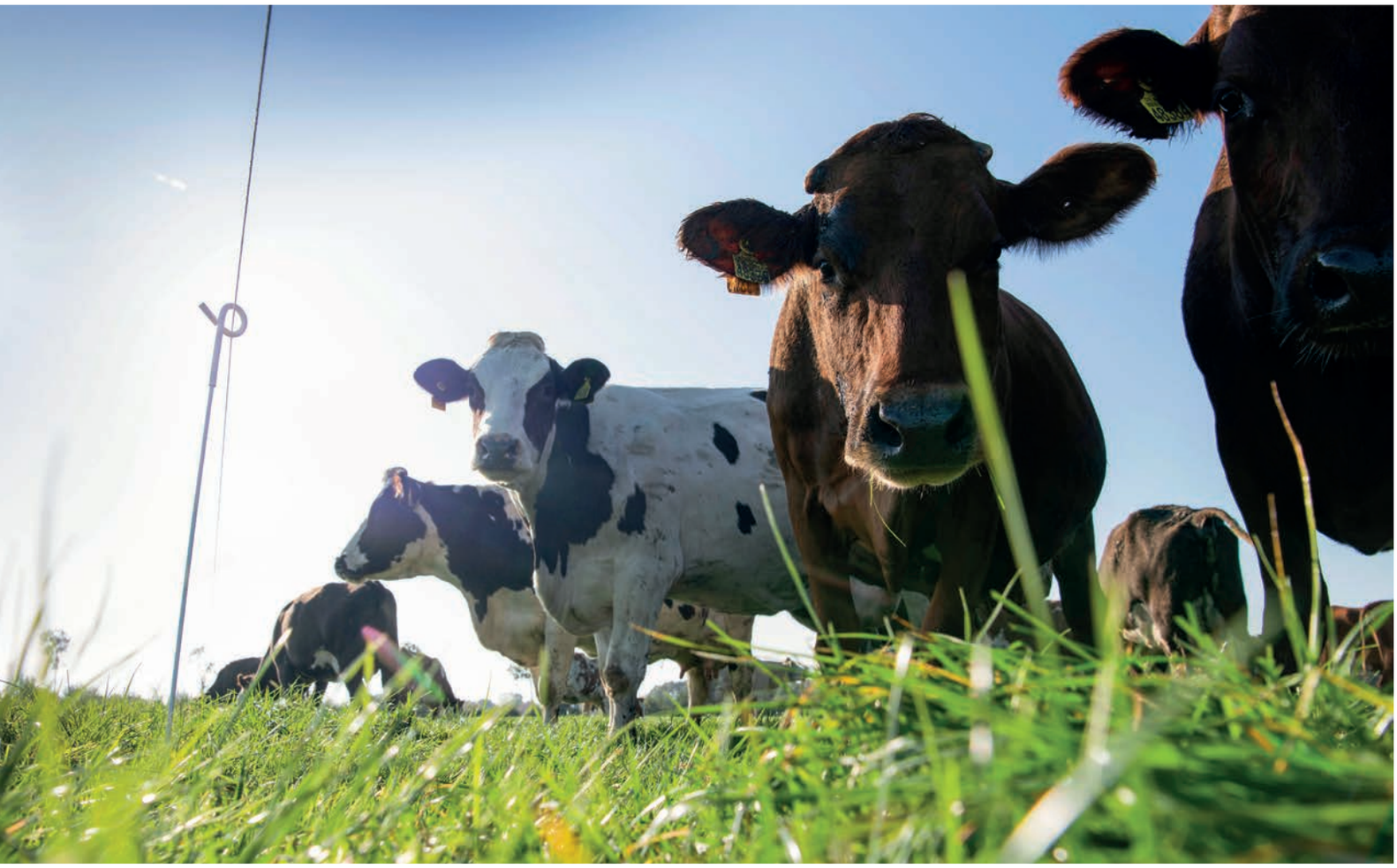
Prof Wall says that, potentially, the work will help to develop a tool to select for cows that produce less methane and offer greater feed efficiency, without compromising health, fertility or productivity.

Tom Gill from Promar International agrees that, when it comes to reducing cows' carbon footprint and GHG emissions, size matters. "If the maintenance requirement of a cow is greater – which it is for larger cows – then her carbon footprint is also bigger. There's no getting away from that," he says, adding that genetics and fertility also account for a proportion of her overall footprint. "A more efficient cow in terms of her productivity – including feed conversion to milk and reproductive performance – will have a lower carbon footprint."

More efficient genetics, he adds, are not necessarily the same as high genetic merit. "Formula 1 cars are the most efficient on the racetrack, but they wouldn't be the best option for your daily commute to work. The same can be said for cows – their genetics must suit the system they're being managed on. It's about utilising the best 'tech' or genetics to get top quality and efficient milk production while, at the same time, lowering or minimising your GHG emissions. Holsteins, for example, are not the best

Marco Winters:

"A feed intake index will help producers to make better breeding decisions"



Greater efficiency: some cows are better at converting feed protein into milk and have lower methane emissions

breed if you're running a tight spring block calving herd on a kiwi-style grazing system."

Cross-bred dairy cattle certainly win here and have a lower CFP than their black-and-white counterparts. "Norwegian Red, and other coloured breeds, tend to produce higher milk solids. Data shows that they are more efficient converters forage, particularly grass, into milk," says Mr Gill.

For those wanting to stick with Holsteins, most, if not all, sires for sale offer improved efficiency and this is heavily correlated with reduced GHG emissions and a lower carbon footprint.

"If producers are more discerning when it comes to sire selection and keep maintenance index and GHG emissions in mind, much larger strides could be made to reducing the CFP through breeding. Couple this approach with all the other aspects of herd and manure management that can reduce GHG emissions and the 1% reduction currently being seen each year through breeding alone could easily move closer to 10%." He cites work on beef breeding, which shows that choice of sire alone can reduce the CFP of a finished beef animal by 11%. "Selecting for better feed efficiency meant that cattle were fit for slaughter 113 days earlier than the control – that's 113 days of feed saved."

To achieve this a high quality ration must be well balanced to ensure good conversion to milk or meat. "But this example shows what can be achieved already. We're only just scratching the surface – imagine what would be possible if researchers and producers really put their minds to it."

Genomic testing

Mr Gill thinks that the potential of genomic testing females is also being underestimated when it comes to reducing CFP. "Again, there's an opportunity here to make a lot of progress – and quickly – towards better efficiency and lower GHG emissions.

"Too many producers are still on a 'breeding' path that costing them a lot of money and isn't offering benefits either up or down the chain," adds Mr Gill. "Any steps taken to reduce GHG emissions and the herd and business' CFP will, by default, improve efficiency. Producers will see a significant financial return.

"The two are inextricably linked and the business will be more sustainable both environmentally and economically. It's a win-win." |

Tom Gill:

"Genomic testing of females presents an opportunity to make a lot of progress"