KELVIN CAVE LTD

KnowHow

Home-grown feed processing and preservation

SUMMER 2023

Focus on feeds and forages

Feeds and forages go under the spotlight. From available options and the environmental impact of their production, to feeding regimes for improving livestock diets.

Also in this issue:

Successful switch to Wagyu with home-grown feeds - page 8.

No more bagged feed for sheep on a Welsh farm - page 19.

Baled TMR is just a click away, thanks to enterprising Herefordshire farmer - page 24.

Picking and mixing your home-grown feeds and forages

Plenty of silage is now safely in clamps across the UK and, as we talk to a cross-section of farmers, we're hearing reports of tremendous variation in both yield and quality. Some early silage is proving to be of an excellent nutritional value but later crops, where cutting may have been stalled due to a break in the weather, had gained bulk but inevitably lost quality by the time conditions improved.

So, now that producers are aware of the quantity and quality they have in store, it would seem the perfect time to assess their options for conserving forage and other home-grown feeds during the weeks and months ahead.

There is plenty of versatility in cereal crops in particular, which could be cut for moist or dry grain, or for traditional wholecrop. Silage expert, Dr Dave Davies of Silage Solutions, looks at a range of options in his article on page 3. For instance, those who have more bulk and less quality so far in the grass clamp may consider crimping rather than wholecropping cereals. Some may also consider crimping a proportion of their maize crop if energy is lacking in their stored feeds.

He also questions the benefit of some cereal/legume bi-cropping options. And he explores the nutritional and environmental benefits of following our European neighbours in taking green-crop wholecrop – only now an option for next year.

One early adopter of this approach is North Yorkshire farmer, Guy Prudom who wholecropped a green cereal crop this April, and shares his experiences on page 7.

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Carbon footprint

We take a strong environmental focus in this issue, in particular through the article on page 10, in which grassland and environment consultant, Dr George Fisher, busts some of the myths surrounding farming's carbon footprint and suggests where big gains can be made by making small and incremental steps. At Kelvin Cave Ltd, we continue to work with farmers in this endeavour, which chimes perfectly with our long-term goal of maximising milk and meat production from home-grown concentrate and forage feeds.

We were therefore delighted to be invited by PGRO (Processors and Growers Research Organisation) to take part in a major new industry/farmer/research initiative which has the ambitious target of cutting soya imports for animal feed in half and has been described as the 'defining project of our time'. We would urge farmers interested in growing more protein on their farms to take part - they can see details of how to do so on pages 22 and 23.

Wagyu

Registrations of Wagyu-sired cattle have grown by 27% this year and we're seeing increasing numbers of customers growing and finishing Wagyu x dairy calves. We were pleased to sponsor the newly created British Wagyu Ambassador Award at the Warrendale Wagyu Conference, and it seemed fitting that this was presented posthumously in recognition of the late Mike Tucker, for his significant contribution to the Wagyu breed. A founding board member and chairman of the British Wagyu Association, Mike has also had a long association with Kelvin Cave Ltd, having been one of our first customers in his dairy farming days. He is sadly missed by many in the industry and fondly remembered for his entertaining commentaries at many of the major agricultural shows.

It was interesting to hear at this event how Warrendale have linked their farmer producers with Genus ABS, Dovecote Park and Aldi, to create a vertically integrated supply chain from conception to consumption. Demand is still outstripping supply and, as more of our customers are considering Wagyu as an option, we are pleased to be involved in this growing sector.
As with all beef cattle *(as we highlighted in KnowHow, Spring 2023, on pages 20-21)* Wagyu require high quality forage. But they are also fed a higher starch diet than other breeds, which helps them achieve the marbling that's important in adding commercial value. So, many producers are finding crimped cereals – which can safely be fed in higher quantities than dry grain – are ideal for this purpose. We feature two producers in this issue who have recently made the switch to Wagyu (pages 8 and 9) and document how they've achieved outstanding performance by supplying high-quality feed to their stock.

Feeding crimp to sheep

All too often, the default position amongst sheep producers is to reach for the bag of concentrates. So, in this issue, we re-visit Martyn and Gruff Jones who have brought great benefits to their beef enterprise over recent years by crimping and improving their silage quality, as explained in the summer 2021 issue of ***KnowHow***. But now, they have ditched the nuts and adopted a crimp-based blend plus silage for their sheep, and seen great improvements in physical and financial performance *(page 19)*.

Buying TMR in a bale

However, not all farmers have the land or infrastructure or even the equipment to grow or mix their own rations but would still like to feed high quality, locally sourced ingredients. So, we also feature Herefordshire producer, Stephen Ware, whose innovative thinking has led to his production of tradeable bales of total mixed ration *(page 24)*. This high-density product – which includes home-grown legume protein – can be easily shipped from farm to farm. And by cutting out the middleman, he's allowing any farmer to feed cattle or sheep a fully traceable, GM-free TMR with a low carbon footprint, with nothing more than a decent fore-end loader or telehandler. Another great example of farm-to-farm trading and 'outside the box' thinking, which can be beneficial to both parties.

Are traditional wholecrop cereals really right for UK farmers?

Dr Dave Davies

Wholecrop cereal silages represent the most diverse forages produced on UK livestock farms. They are diverse both in nutritive value and fermentation quality and very often this is due to the decisions made between sowing and harvest. Often these decisions are made late in the season as a result of external factors, such as weather to fill the forage gap caused by the drought. But was this the best option?

As with all forages to be ensiled it is important that the producer of the silage is aware of all factors, often conflicting, before making decisions on how and when to harvest. The target must be how that silage will fit into the jigsaw puzzle of available feeds and the class of stock being fed on the farm to balance yield and quality with the requirements of the stock to produce milk or meat as efficiently and cost effectively as possible. Within this article I hope to highlight points to be thinking of when making your decision.

Pure cereal silages - the traditional approach to wholecrop

Many farmers consider wholecrop to be a high energy crop, but in fact this is not the case. In a report examining all the silages submitted for analysis through the Farming Connect Knowledge Exchange Programme in Wales from 2014-2017, the average wholecrop analysis had a metabolisable energy (ME) of 9.6MJ/kg DM and crude protein of 12.2g/kg DM with the top 20% only achieving an ME of 10.3MJ/kg DM and a crude protein of 15.4g/kg DM. This compares to the same dataset for grass silages submitted, where the average was 10.3MJ/kg DM and crude protein was 13.1g/kg DM, with the top 20% being 11.6MJ/kg DM of ME and crude protein of 16.6g/kg DM.

Thus, the question should always be, what do I want to achieve with the wholecrop silage and is this the best option for harvesting the cereal?

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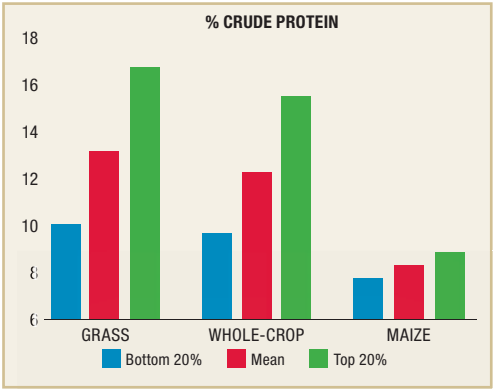
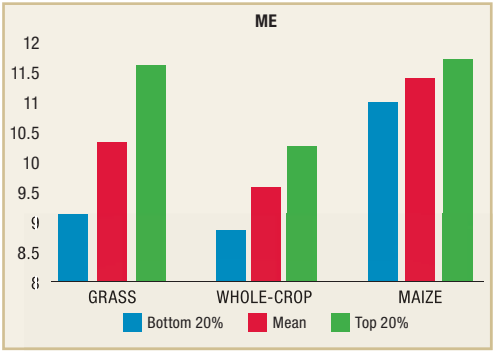


Crude protein % of different forage types. (Source: Farming Connect)



Metabolisable Energy (MJ/kg DM) of different forage types. (Source: Farming Connect)

The answer to that question is not a straightforward one, as there are a number of other factors that need to be considered.

First and foremost, it is important to remember that around 70-75% of the weight of the wholecrop forage is straw, with 25-30% being grain. Harvesting by combining either at the crimping or dry stage allows flexibility in feeding the straw and grain separately at the required levels to match the ration to the class of stock being fed in terms of nutritional and structural requirements. Even in a year where forage is short, harvesting at the grain stage will enable precise quantities of straw to be fed, rather than relying on the mix that was harvested as the wholecrop.

In a year with compromised forage yields, the quantities of straw fed can be increased to offset the yield lost by other forages, but this is still a more precise way of managing the crop than the wholecrop approach. The problem with the straw part of the wholecrop is that it has poor digestibility – around 50% maximum – and it has a slow passage rate. Thus, in productive livestock it will reduce the intake of the whole ration, and consequently reduce production, be that meat or milk. However, it is advantageous in maintaining a good supply of effective fibre and maintaining a healthy rumen. Thus, it is a balancing act. For the non-productive animal such as dry cows, be they dairy or sucklers, then wholecrop is a potential option.

If this traditional wholecrop approach is the best option for you, it should be harvested at around 35-37% DM and the grain should be at the soft cheese stage of growth. Many producers harvest at dry matters above this to maximise starch yield. However, if a corn cracker is not working effectively during the harvesting process, whilst the forage may contain more starch, a bovine animal consuming the wholecrop will not be able to digest the starch efficiently and much of the grain will pass straight through the animal undigested. This will result in a much larger loss of starch than harvesting at the earlier stage of growth.

If the wholecrop is to be baled, then a maximum dry matter of 35% should be the target as baled silage will not have a grain processor and the softer grains are less likely to pass through the gut undigested. Once harvested, the wholecrop should be chopped to a maximum chop length of 3cm to ensure good compaction. Remember, wholecrop is a dry crop with a lot of straw. Good compaction is absolutely key to maintaining good aerobic stability at feed-out. Chopping finely has two effects in wholecrop silages: it aids better compaction of a dry crop and it shortens the length of the straw for gaseous movement (CO_2 out and O_2 in) into the clamp face at feed-out.

Remember straws are used by children to have fun at parties making a right royal mess. Long chopped straw in your clamp enables yeasts and moulds to have fun at feed-out of your clamp, again making a right royal mess.

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Green-crop wholecrop – is this a better option?

If we look away from these shores and examine what is happening in drought ridden countries of central and southern Europe, Israel, and certain parts of the USA, we find that cereals harvested as silages are now being taken earlier and used as a replacement for grass silage that

cannot be grown due to heat and drought. These silages can have 18% crude protein, D-value of 75% and an ME of 12MJ/kg DM. To do this these crops are harvested before any seed stem has emerged from the sheath, so they have no starch but their purpose is to provide highly digestible cell walls. If they are harvested at this stage of maturity, they will regrow as a grass and can produce a second harvest. Harvest management is just like that of any standard grass for ensiling.

Feeding crimped cereals alongside some straw if required may be better than feeding traditional wholecrop. ***Above:*** *Contractor, Luke Gardner, crimping wheat in Lancashire.*

This approach would suit many UK growers who are in drought-prone areas who grow maize. High maize inclusion in diets generally supply plenty of starch, but fibre digestibility and protein are low so the two forages complement each other well.

Drilling in the autumn and harvesting prior to drilling maize also eliminates the issues associated with over-wintering bare stubbles.

If you already suspect you may be short of forage early enough in the year, taking two cuts of a cereal destined for combining may be a far better option nutritionally than the traditional wholecrop approach.

Mixed grass/legume wholecrop forages – are they worth considering?

Two other options to consider are undersowing with grass/clover where the cereal is being used as a cover crop to improve establishment, or growing the cereal with a legume be that peas, beans, vetches, or even lupins.

There may be some merit in the first option but, with regards to cereal/legume mixes, it is a common misconception that they produce a silage that is both high in energy and protein. They are the most difficult crop to get right both in terms of nutritive value and preservation quality and feed-out. This type of cropping regime will never produce a high energy and high protein forage and most often it will have less than average energy and protein content compared to a good grass or grass/clover silage. The main reason for this is that the stem of the cereal will always dilute both the energy and the protein and secondly that the higher protein legume in the mixture will dilute the higher starch containing cereal and vice versa.

Harvest these crops either when the:

1. Cereal grain is soft – a very small amount of liquid is far preferable to a solid grain difficult to crush between your fingers.
2. Grain legume has a fully elongated pod that is just starting to fill.
3. Undersown grass/clover is at the correct stage of maturity for high quality silage.

Once the decision to harvest has been taken these crops require mowing, leaving a minimum of a 7.5cm but ideally 10cm stubble height. This should be followed by a rapid wilt to the optimum dry matter, which for a clamp would be 30-34% DM and for bales 35-40% DM. All these forage types should be chopped whether ensiled in a bale or clamp and for clamp silage, a maximum chop length of 5cm should be used.

Additives

It is always important to consider the additive with respect to the crop being ensiled and both the issues met during the anaerobic fermentation phase as well as the aerobic phases during filling, sealing and feed-out.

With this in mind, and breaking down the crop types

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mentioned above into three distinct groups for their preservation challenges, these are:

1. Mixed wholecrop cereal and legume/grass mixtures.

These have significant challenges for both fermentation and aerobic stability. Fermentation due to the high buffering, high protein legume, the higher risk of soil contamination, and the potentially lower percentage dry matter content. And aerobic stability due to the straw content from the cereal portion. Therefore, these crops need an additive that can aggressively assist in controlling all aspects of ensiling. Ideally this crop needs a chemical additive that contains salts that will inhibit the clostridia and enterobacteria (sodium nitrite for instance) and the yeasts and moulds (eg sorbate and benzoate).

If producing the forage in an organic system, then a homofermentative inoculant applied at 1,000,000 bacteria/g fresh forage will control the fermentation, and to control the aerobic stability an organically-approved chemical such as citrate should do the trick.

2. Green crop cereal.

The main challenge from this crop type is fermentation, due to the high protein content and again potentially lower percent dry matter. Therefore, a good 1,000,000 bacteria/g fresh forage homofermentative inoculant product would cover these bases. If you have concerns about aerobic spoilage then the citrate approach alongside the homofermentative inoculant or a chemical salts-based additive will again assist in ensuring a good preservation process.

3. Standard pure wholecrop.

This has a big challenge from aerobic stability issues and generally few issues with fermentation. Thus, this forage type requires a chemical additive based predominantly on sorbate and benzoate salts to control the yeast and mould populations. Again, a combination product with a homofermentative 1,000,000 bacteria/g fresh forage plus an organic chemical can solve these issues on organic farms.

Many of you out there will have been told that the inoculants containing heterofermentative bacteria either alone or in a mix with homofermentative inoculants will control both the fermentation processes and the aerobic spoilage processes. These products rely on the production of acetic acid and propane-1,2-diol to control aerobic spoilage and these compounds need to be produced in sufficient quantities to control the yeast and mould populations. Frequently, they do not produce these compounds fast enough or to a high enough concentration to do their job, especially when the DM of the forage is approaching 40%. In addition, to achieve the required activity from the heterofermentative bacteria in the product they reduce the level of the homofermentative bacteria, which then results in the fermentation not being controlled sufficiently. This all results in higher dry matter losses and more importantly higher energy losses. This has been scientifically proven time and again.

Finally: enzymes.

Enzymes as components of commercial silage additives have extremely limited evidence of any activity. This is due to a number of factors:

1. Enzymes are only active over a relatively narrow pH range and your silage is likely to be at the correct pH for a matter of a few hours.
2. Enzymes are proteins and the silo contains many proteolytic enzymes that breakdown proteins and the enzymes added as part of the inoculant will also be broken down by the plant enzymes in the silage.
3. The enzymes require water to work, so the higher the DM of the silage the less water there is so the slower they will work.
4. The enzymes are added in extremely low concentrations, and frequently in an insufficient quantity to have any meaningful effect on either the release of sugar to drive the silage fermentation or solubilization of fibre to improve digestibility.

In conclusion, please never buy a silage additive because it contains enzymes; buy it because all the other components fit what you require.

Above: *Green wholecrop rye made in Yorkshire this spring replenished low forage stocks on Guy Prudom's farm (see article opposite).*

Early adoption of green-crop wholecropping in UK

North Yorkshire beef and arable farmer, Guy Prudom *(above)*, harvested rye as a green wholecrop this spring, and is believed to be one of the UK's earliest adopters of the practice.

Using a process more commonly seen in drier climates, he direct drilled the rye last September and harvested the crop on 27 April, before any seed heads had emerged.

The impetus to try this practice came from Guy's low forage stocks following last summer's drought. He was also keen to grow maize for the first time but did not want to leave land bare over winter.

Opting to direct cut the crop, the field was then sprayed with glyphosate after harvest and had six tonnes/acre of farmyard manure applied. The maize was sown with a Mzuri strip-till drill, which suited Guy's regenerative farming approach on this tenanted 500-acre (202ha) farm.

The green-crop wholecrop was preserved with the homofermentative inoculant, Activator Plus. It analysed with a dry matter of around 20%, a D-value of 74, crude protein of 10.56% and metabolisable energy of 11.8MJ/kg DM.

However, Kelvin Cave's technical director, Michael Carpenter, says that standard UK NIRS calibrations are potentially inaccurate in unusual crops such as this as they don't really fit as either a traditional wholecrop or as a grass. This analysis was therefore an average of four scans from a NIRS4Farm hand-held scanner, using both the traditional wholecrop and grass calibrations.

"These values are what we would expect when comparing it to results from other countries although crude protein is lower than expectations," he says. "But this is probably due, in part, to low fertiliser of only 25 units/acre or 30kg/ha application on the crop."

However, the crop of rye fulfilled its purpose, allowing Guy to replenish his silage stocks early in the season. It will be sown again this year after winter barley and before a spring crop.

For more details on Guy Prudom's farming activities, see the Spring 2023 issue of KnowHow.

Below: *Direct-drilled in September, forage rye taken as green-crop wholecrop on 27 April in time for drilling maize.*

Kelvin Cave Ltd was pleased to be a sponsor at the Warrendale Wagyu Conference held this spring, and we feature two producers who have recently converted to the breed. Both their systems achieve outstanding performance, and both are dependent on high quality feeds preserved with KC products.

Crimped grain pushes Wagyu performance beyond expectations

When Rick and Vicky Massey *(pictured above)* retired from milking Holsteins at Chesham Farm in Chorley, they looked for a replacement enterprise which would meet several needs.

"We wanted it to pay the rent, pay the bills, pay a long-term member of staff, be easier to run and allow us to stay on the farm," says Rick.

They found the answer in rearing Wagyu beef on home-grown crimped cereals – a combination which has ticked every box on their wish list. Such has been its success that the couple have retained their stock for finishing, having initially planned to sell them as stores.

Buying their Wagyu x dairy stock in 2022 through Warrendale Wagyu, they say several aspects of the system have exceeded expectations, not least, the cattle's growth rates.

In fact, he says: "We've asked [independent nutritionist] Lizz Clarke to come to the farm as we want to make sure we're not growing them too fast!"

Lizz provides reassurance that the Wagyu beef will do particularly well on the high starch diet and explains why she's increased the crimp in the finishing ration.

"The longer you feed a high starch diet, the higher the marbling, so feeding it through growing and finishing is ideal," she says.

The finishing ration is therefore formulated with 11kg crimped barley, 12.5kg grass silage, 0.5kg molasses, 1.5kg rapeseed meal and minerals. This analyses with an ME of 12.4MJ/kg DM, protein of 14.1% and starch of 32.2%.

She says: "Crimp is a particularly safe starch product which can be fed in higher quantities than dry cereals, without the risk of rumen acidosis.

"This makes it a valuable feeding resource and perfect for feeding Wagyu cattle," she says.

With Lizz's reassurance, Rick acknowledges that the faster-growing cattle will increase the profits for the farm.

"The sooner we can get them away, the more profit we'll make, as long as we can get the marbling right," he says, remarking that he sells to Warrendale, whose pricing structure for Wagyu rewards more marbling.

Agronomic benefits are also increasing the value of crimp on the Masseys' farm which comprises around 260 acres, of which 30 acres have now been assigned to barley for crimping.

Rick says: "A big advantage of crimp is being able to cut it a couple of weeks earlier than dry grain. We are in a wet area of Lancashire and if we can combine the grain in July and plough and redrill by September we are on to a winner.

"We don't have any dry grain storage on the farm and we're not geared up for drying. So, the fact that we can clamp the higher moisture crimped grain gives us a simple and guaranteed product."

Crimping grain

- Harvest is taken at moisture contents of 25%-40%
- Grain is rolled and has a chemical, salts-based preservative applied
- No drying or specialist storage is required – only a clamp or tube
- Nutrient value, digestibility and dry matter/ha are maximised
- Provides a safer way to feed high starch rations than dry grain
- Improves animal performance over dry-rolled cereals
- Harvest is earlier and less weather dependent
- Reduces grain loss in the field and can help in blackgrass control
- Allows early establishment of follow-on crops

Wagyu on grass silage-based ration boosts financial performance

Fraser Scott has been a large-scale commercial beef producer on his 2,600-acre Northumberland farm for many years, but only recently put a toe in the water with the Wagyu breed.

First buying 87 head in 2022, he had to overcome preconceptions about the breed which he quickly discovered were misplaced.

A total mixed ration was compiled by independent nutritionist, Lizz Clarke, which comprises grass silage, waste potato chips, barley, Vitagold, with minerals and limestone flour.

Silage is treated with Kelvin Cave's top-of-the-range preservative, Safesil Pro, which is said by Fraser to be essential in maintaining the ration's quality.

"You can't finish beef cattle on what I'd call suckler cow silage and Safesil is vital for enhancing our forage quality," he says. "It allows us to move across a 90-foot-wide silage face with complete confidence that the forage has retained its nutritional value and will remain stable and cool."

The overall TMR analyses with a metabolisable energy (ME) of 12.6MJ/kg DM, protein at 14.5% and starch at a hefty 34%.

Lizz explains: "The Wagyu have to be fed a high starch diet, ideally through the entire growing and finishing period, to achieve the required marbling."

This is fed at a rate of 30kg (freshweight) per head, achieving a daily dry matter intake of 12.6kg.

Remaining on the farm from around 18-19 months to 23-25 months and from around 450kg to an average weight of 680kg (heifers and steers), the F1, dairy cross Wagyu kill out at a target average of 52%.

Fraser says he's very pleased with the outcome for the Wagyu business so far and will continue to bring in stock through Warrendale Wagyu's integrated supply chain.

He says: "It's a much more relaxing way of finishing beef than dealing with the turbulence of store cattle prices.

"We pay a fixed price for stores in pence per kilo; the cattle arrive with no transport cost; and there's no carcase weight limit; no killing charges; and we have a ration put together by Lizz.

"We are paid a base price of £5 per kilo and we find they finish remarkably well. And if we can achieve a high score for marbling we are significantly better off."

The top marbling score achieved by the farm has been nine and the best-performing animal in the farm's first batch had a 416kg carcase with a high marbling score.

Fraser Scott and his son, Oliver, above with a group of Wagyu, aged around 20 months and below, inspecting the silage.

FARMING and the CLIMATE DEBATE

How raising our understanding can make a difference

Livestock farming is in the firing line for its greenhouse gas emissions. Here, grassland and environment consultant, Dr George Fisher, argues where this can and cannot be justified and pinpoints some of the biggest and easiest gains.

With the popular press and mainstream media pointing fingers at agriculture for greenhouse gas emissions, and at milk and meat production and consumption in particular, it is easy for farmers to feel 'got at' when it comes to the climate change debate. Add in the fact that there are around 50 different farm carbon accounting tools available, all giving different answers to the question 'what is my farm's carbon footprint?' and it's easy to see how confusion can reign for farmers trying to produce heathy food in a responsible way and struggling to make a profit from doing so. An explanation of the numbers helps demonstrate how to focus on the main issues, and - with the aid of Kelvin Cave's approaches to forage production and management - can help producers make some progress.

Farming carbon emissions – the latest

The most recent numbers available from The Department of Energy Security and Net Zero are for 2021 and were published in March 2023. They show emissions from agriculture were 49.2 million tonnes (Mt) for the year, 11.5% of the UK total of 426.5 Mt. Enteric methane emissions (from rumination) from all of the cattle in the UK (the infamous belching cows highlighted by the mainstream media) were 18.1Mt – that's 36.8% of agricultural emissions and just 4.2% of the UK total.

With industry use of gas and electricity at 17% of total UK emissions, passenger car use at 15% and residential use of gas and electricity at 23%, we can see why it feels unfair for there to be such a focus on cattle that are producing milk and meat foods. If it helps, cattle farming is not the only sector to have an inappropriate level of public scrutiny - the aviation industry also seems under the cosh at the moment, and in 2021 all domestic and international flights accounted for a whopping 0.5% of UK greenhouse gas emissions!

The reality is that our Government is signed up to various protocol and targets to reduce greenhouse gas emissions, and every sector (agriculture, transport, business, public sector, industry, residential, waste management) is expected to take action to reduce emissions.

So, like it or not - unfair or not - overblown or not, we are on a 'net zero journey' and that means measuring where we are and planning to make reductions.

In case anyone is wondering, 'net zero' simply means a position where all the greenhouse gases we emit are balanced by all the greenhouse gases that we capture.

Greenhouse gases – what they are and how they lead to climate change

The greenhouse gas effect is a natural phenomenon. It's how the climate of the earth exists so that we can have life on the planet. Energy from the sun warms the earth's surface and this energy comes in a variety of wavelengths. Energy in the infra-red wavelength hits the earth, warms it and is then released up into the atmosphere, where some escapes back into space and some is absorbed by greenhouse gases. These gases then release the infra-red radiation back to the earth, where it again warms the surface. This is the same process by which greenhouses are warmer than the air outside (the glass traps some of the energy and chucks it back into the greenhouse). Hence the name.

So, we need greenhouse gases in the atmosphere to keep the earth warm, otherwise we'd all be living in arctic conditions (or more likely, not living at all). But the more greenhouse gases there are in the atmosphere, the more infra-red radiation is trapped and released back to the earth, and the more global warming we have. If we want to keep the earth from warming too much (the widely quoted safe limit of 1.5°C), then we need to pump less greenhouse gas into the atmosphere.

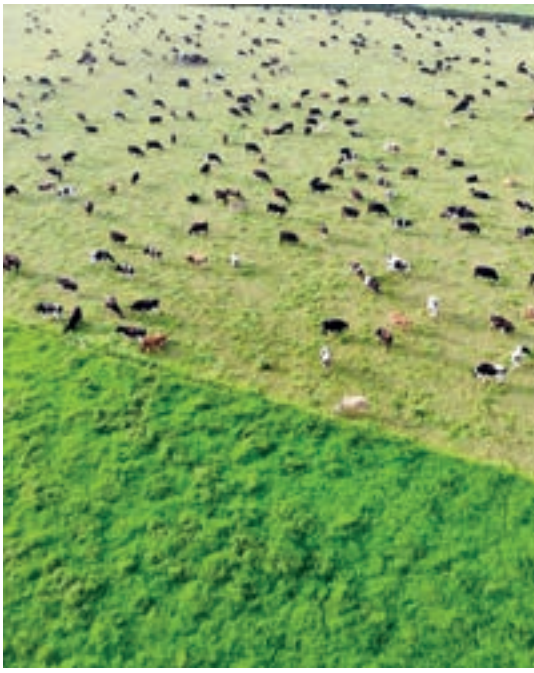
The three main greenhouse gases are carbon dioxide, methane and nitrous oxide. The table below shows their greenhouse gas potential and how long they last in the atmosphere.

The main greenhouse gases and their warming potential

Greenhouse gas	Chemical symbol	How long they persuist in the atmosphere (years)	100-year global warming potential (Warming effect relative to CO_2)
Carbon dioxide	CO_2	300 - 1,000	1
Methane	CH_4	10 - 12	25
Nitrous oxide	N_2O	Over 100	298

These three gases trap infra-red radiation at different rates and this is why they are distilled down to 'carbon dioxide equivalence'. So, releasing 1kg of methane has the same warming effect as 25kg of carbon dioxide, and 1kg nitrous oxide is the same as 298kg carbon dioxide.

All three gases are emitted by agricultural practice and



operations, so your farm carbon footprint makes a calculation of the three gases emitted, based on what and how you farm, and expresses them as a carbon dioxide equivalent (CO_2e). The accounting tools use different models to predict the emissions of these gases, based on how you farm (amount of forage produced, fertiliser applications, concentrates fed, tractors driven, electricity used, etc), so they all come up with different overall numbers for the same farm.

So, the practical lesson here is, choose the carbon footprinting tool that best suits your farm and stick with it. Your milk or meat buyer might insist on the use of a certain tool anyway, so for many of us, this decision is taken out of our hands.

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Where do the gases come from on-farm?

For agriculture, around 13% of emissions come from carbon dioxide, 33% from nitrous oxide and 54% from methane. The table below gives some indicators of the operations that release these gases.

The main sources of greenhouse gases on-farm

Carbon Dioxide (1.7% of UK emissions come from agriculture)	**Nitrous oxide** (68% of UK emissions come from agriculture	**Methane** (47% of UK emissions come from agriculture
Farm diesel use	Use of manufactured nitrogen fertlisers	Ruminant digestion ('enteric emission')
Electricity use	Application of slurries and manures	Slurry storage
Liming and urea applications	Dung and urine from grazing livestock	
Ploughing	Nitrogen fixing legumes	
	Ploughing in crop residues	
	Slurry storage	
	Ammonia loss (indirect emission)	
	Nitrate leaching (indirect emission)	

Why are emissions from agriculture counted the same as for other sectors?

This is a difficult one to answer and highlights some of the challenges in our current thinking on greenhouse gas emissions across the globe.

Challenge 1 - Greenhouse gas emissions from agriculture are inextricably linked to food production, an activity that is a priority for humanity. Other emissions, like those from transport and the production of 'nice to have' items and activities like TVs and DIY are not such a priority. This is a debate that is not heard, but as food security becomes a bigger political issue, then maybe it will be aired.

Challenge 2 - The emissions from agriculture arise from 'short-term carbon cycling'. Most of the carbon that is consumed in cattle feed was captured from the atmosphere in the last few years from crop and grassland production. This is in stark contrast to the emissions from transport fuel use and the use of gas and electricity for heating, cooling and lighting, which comes from carbon that has taken millions of years to capture in oil and gas. This is another angle that is not really discussed, although protests against fossil fuel extraction and use are certainly more high-profile than those against agriculture!

Challenge 3 - As most agricultural emissions come from methane, and methane lasts only a relatively short time in the atmosphere, why is there a focus on belching cows? There are two sides to this viewpoint: on the one hand, there are measurement approaches that take this into account and as the debate rolls on, it might be that methane is not seen as such a problem greenhouse gas. On the other hand, because of the relatively short life of methane in the atmosphere, reducing emissions is the fastest route to lowering the amount of greenhouse gas in

Cutting manufactured nitrogen can help reduce a farm's carbon footprint.

Improving slurry application methods can significantly cut GHG emissions.

Right: *Fertiliser manufacturing has a high carbon footprint.*

the earth's atmosphere and thereby controlling global warming.

Areas to focus on

There are a lot of 'first three things to consider', and 'top five tips' out there when it comes to reducing greenhouse gas emissions. The good news for cattle farmers is that most of the reduction measures are associated with increasing the efficiency, and therefore potential profitability, of milk and meat production.

It is interesting to look at what the supply chain are focused on for their primary food producing farmers. An example worthy of exploration comes from Arla, who facilitate the carbon footprinting of around 2,000 of their dairy farmers in the UK every year. Their analysis shows a carbon use of 1.1kg CO_2e per kg milk, which compares with the UK average of 1.25 and the global average of around 2.5kg CO_2e per kg milk.

Arla has five priority areas for carbon reduction, and what Kelvin Cave Ltd does fits directly into four of these:

1. Feed efficiency - reducing the kg dry matter fed per kg milk. Making and preserving the highest quality of home-grown feed and forage reduces brought-in feeds, which mostly have more cost in terms of both cash and carbon. A kilogram (dry matter) of dairy parlour concentrate typically costs at least twice as much to feed as a kilogram DM of home-grown preserved forage and at a carbon accounting cost of around 1kg CO_2e per kg concentrate. Making the most of home-grown energy and protein has been the focus of the Kelvin Cave business for over 40 years, so if you follow the company's approach and choose your options wisely, you'll make progress on this score.

2. Protein efficiency - ruminants are inefficient users of nitrogen, which is the main constituent of proteins. Raising nitrogen use efficiency, even by a small amount, say from 20-25% per animal, will reduce the amount of surplus protein in the farming system and cut losses from nitrous oxide. Kelvin Cave Ltd is part of a national research consortium looking at developing systems for producing more high quality home-grown protein using peas and beans, so watch this space over the next four years for ideas, approaches and support.

3. Reducing mortality - lower replacement rates mean fewer rumens on-farm and fewer rumens mean lowered enteric methane emissions.

4. Reducing the use of manufactured nitrogen fertilisers - The carbon cost of bringing manufactured nitrogen on farm and the nitrous oxide emissions from their application can represent 10-20% of a cattle production system's carbon footprint. So, anything that can be done to reduce the need for nitrogen fertilisers will help with the pocket and with carbon. Credible, evidence-based slurry additives like Digest-It from the Kelvin Cave stable, can improve the availability of nitrogen in slurries and thereby cut the use of nitrogen fertilisers by 20-30kg N/ha. That represents a 4:1 return on investing in using the product and a reduction of 130-195kg CO_2e per ha.

5. Improved crop yields - Arla express crop yield as the m^2 it takes to produce a kg of milk. The approach is, the more crop yield you have, the more milk you can produce from your land and therefore you get more milk for the carbon you use. In other words, it's a different measure of efficiency. What we tend to forget here is that it's not just about crop yield when it comes to making grass and maize silage or crimped grain. It is also crucial to preserve that quantity and quality without losing dry matter from the clamp during ensiling and feedout. This is where the Kelvin Cave approach helps again - the company is all about providing you with the products that give you the best of both worlds when feeding your preserved feeds, which means focusing on preserving the amount and quality of what you have harvested right to the animal's mouth.

To sum it up, the carbon reduction, net zero journey is not going away. Your main customer is under pressure to show what they are doing about it, as well as the rest of the supply chain, from your farmgate to the consumer's dinner table. The opportunity is that most of the reduction measures at the farm level also improve efficiency and therefore potential profitability. The good news is that Kelvin Cave has important solutions for your farm and is at the forefront of developing improved approaches for the future.

CHAIN REAC

A chain is only as strong as its weakest link

Making great home grown feeds is a chain reaction that links each stage of production, through processing, preservation, preparing, packing and protecting, ensuring the products and techniques employed combine to deliver great results time and again.

Just one weak link in the process risks breaking the chain, thus jeopardising the overall quality, nutritional value and palatability of your feed crops.

But it doesn't have to be that way.

Working in unison, these products are proven to help farmers produce great quality silage, even in the most challenging conditions.

PRESERVE

Safesil Pro or **Safesil Challenge** for all forages dependent on dry matter. Will ensure fast efficient fermentation with maximum nutrient and dry matter retention and minimal aerobic stability losses at feedout. Safesil Pro is ideal for wholecrop, producing a clean fermentation, resulting in a more palatable and richer in nutrients feed from wholecrop and pulses.

CrimpSafe 300 and **CrimpSafe Hi-Dry** - CrimpSafe 300 ensures a controlled fermentation and maximum nutrient retention for ensiled crimped grain above 25% moisture content. For effective preservation and ensiling of grain below 25% use CrimpSafe Hi-Dry.

Propcorn NC - is a proven, non-corrosive successor to Propcorn. Safer to use, and with 70% less fumes than straight propionic acid, it is suitable for preserving whole or rolled grain and pulses with a moisture content of up to 25%, in aerobic conditions.

Proflake NC - is designed to improve the physical quality of dry-rolled grain, and increase the storage life of processed cereals by up to 3 months. It inhibits yeasts and mould growth, and mycotoxin formation and ensures significant reduction in dust levels, helping to improve animal health and performance.

PROCESS

Grain Crimping Machines and **Dry Grain Roller Mills** - to suit every size of projected throughput for cereal grains and pulses, either dry (up to 25% moisture) or crimping and ensiling (from 25 to 45% moisture). We offer an extensive range of Finnish-manufactured Murska / Korte machines that meet our exacting standards of engineering excellence and reliability.

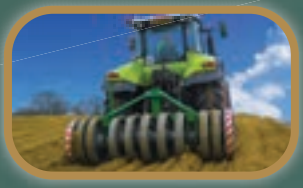
BaleSafe - treating with BaleSafe allows hay and straw to be safely baled up to 25% moisture without wrapping and also reduces DM loss and improves stability in wrapped haylage at 50-75% DM.

PREPARE

KlampClips - like an extra pair of hands during clamp filling. Manufactured from sprung stainless steel and made-to-measure for different clamp wall thicknesses. Available in packs of 25.

Side Sheets - essential to ensure a complete airtight seal. Heavy duty, 150µm, clear plastic in 50-metre rolls and in widths of 4, 5, 6 and 8 metres.

PACK



SilaPactor - available in a range of widths from 2.1 metres to 4 metres, weighing from 2.5 to 6.0 tonnes. A SilaPactor can increase compaction density by up to 40%, is proven to cut DM losses and it saves time and fuel.

PROTECT

Farmguard - high-strength, recyclable silage sheeting. Uses advanced seven-layer technology for improved durability and tensile strength, tear resistance, a high degree of UV protection and easy, lightweight handling. Farmguard's barrier to oxygen is up to 100 times that of standard silage sheeting.

O_2 Barrier 2in1 - the single sheet which transforms into two. Polyamide vacuum film layer up to 10 times less oxygen-permeable than conventional silage film that reduces time and labour required to seal the clamp.

BaleShield 160 - durable protection for hay, straw and wrapped forage bales. Tear-resistant waterproof fleece can be used time and again. Ideal for protecting forage in the open close to where it's needed. Sheets can be joined with hook and loop tape and held in place with clamps and screws supplied.

ClampShield 500 - the ultimate protection for ensiled forage crops but with up to 75% less single-use plastic. This breathable polypropylene fleece can be reused over many years. Waterproof, easy to lay, and affording protection against birds. Sheets can be joined with hook and loop tape.

All change in farm contracting

Bowing out after 20 years ...

Above: Peter Holloway is retiring from his crimping business but continues to farm. Many of his stock are sired by a bull bred by the Lewis family, who are taking on Peter's crimping business.

Kelvin Cave Ltd is indebted to farm contractor, Peter Holloway, who is retiring from contracting after over 20 years in the business.

Peter has been a keen advocate of crimping throughout those years, having introduced the process to his own farm in mid-Wales and spread the word of its benefits throughout the region.

He will continue to farm at Mount Farm in Welshpool, but his crimping machine – a high throughput KC Bruiser – has been sold to nearby farmers, CV & EM Lewis & Sons, who will now offer a grain rolling and crimping service as part of their contracting business (see opposite).

Peter recalls how he first saw crimping at a ploughing match in Ireland, and, as an asthmatic, was particularly attracted by the absence of dust from the milling process, with moisture contents of the rolled grain for crimping being over 25%. Purchasing a second-hand Murska 700, he then moved up to a Korte 1000, followed by a Korte 1400 and 2000, and on to the KC Bruiser.

Throughout that time, he always used the Kelvin Cave recommended crimping preservative, which has latterly been CrimpSafe 300, with its proven ability to keep grain stable through storage and after opening the clamp.

He says: "The Kelvin Cave products have always worked and I would not have taken the risk of using anything else."

After introducing crimped grain to his own stock, he soon realised its virtues extended far beyond his own health and the product's excellent keeping quality. Having kept a herd of up to 140 spring calving, dairy cross continental suckler cows, he found their progeny could be fed ad lib crimp and achieve excellent performance, from weaning in October until they were sold as stores at 10-13 months.

The convenience of storing crimped grain is cited as a further benefit and he says in the early days he would make a temporary clamp out of round bale silage. Today, his own clamps are a permanent fixture.

Completely won over by the product soon after taking it on, he also praisesxthe service from Kelvin Cave Ltd, firstly from former technical director, Andy Strzelecki (now retired) who helped him build his customer base and latterly from Richard Parks, who has always been on hand with advice from the Kelvin Cave workshop.

Kelvin Cave Ltd would like to wish Peter and his son, Ross, well with the continuation of their farming business.

in mid-Wales area

Taking on the crimping role ...

Colin Lewis and his family are stepping up to take over Peter Holloway's crimping business, which they will add to their existing contracting services under the banner of CV & EM Lewis & Sons.

Colin has been a crimping enthusiast for at least 10 years, and of the many features he appreciates about the product, the performance of his pedigree Limousins is at the top of the list.

The family's Garyvaughan Limousins are not only the current holders of the herd championship for the North West Midlands and North Wales Limousin Club, but they have taken this title for an impressive eight of the past 10 years.

The 130-head suckler herd produces around 40 to 50 breeding bulls every year, so presenting these in top condition is essential for the success of the business.

The bulls go through the ring in Carlisle, Brecon and Welshpool or sell privately, having reached prices of up to £32,000. Their outstanding performance is achieved with virtually all home-grown feeds from the family's 382-acres (155ha) at Buttington New Hall near Welshpool, where Colin's wife, Elaine and sons Graham and Terry are all part of the business.

Above: *Feeding* ***ad lib*** *crimp to Limousin bulls has led to exceptional performance in Colin Lewis's Garyvaughan herd.*

Right: *Colin (left) and Graham Lewis.*

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Colin says: "We are competing against people who would spend an awful lot more money on feed than we do, so it's essential we focus on quality."

This means making the best round bale haylage and silage they can, which is fed with ad lib crimped barley. To this, just add a small amount of sugar beet pellets with vitamins and minerals are added.

Crimp to calves

This is offered to calves to nibble from as little as three weeks of age to drive early feed intakes and exploit the best feed conversion efficiency attainable from the youngest animals. The same ration continues to be fed through to finished stock and young breeding bulls, which consume up to an estimated 10kg/head/day.

Colin says he values the crimp's versatility and simplicity of feeding, and says having just one ration for all ages of stock suits the farm's system.

"We also find the crimp is much more rumen friendly - we wouldn't have been able to feed the same volumes of dry grain," he says. "We used to put molasses with the dry grain we've fed in the past to make it more palatable but don't need to do this with crimp."

The result is average daily liveweight gains of 1.6kg throughout their rearing period but they can hit 2kg/day 'when they're flying'.

This is mirrored in the most recent kill sheet for nine bulls that didn't make it into breeding. This shows the group achieved an average deadweight of 392kg and average killing out of 63%. They achieved this at an average 12.4 months of age, with seven of the nine head achieving carcase grades of E - the others grading U.

Colin says: "It would be very hard to achieve this with other feeds but the palatability and high nutritional value of crimp makes this performance possible.

"The moist grain for crimping comes in from the field at its optimal nutritional value, in contrast to dried grain, which has started to die off and lose its nutritional quality."

Producing the crimped grain itself is also said to suit the farm and the contracting business well.

"It suits our system to combine, clamp and crimp, and that's the job done," says Colin. "And if we can do that three weeks earlier than with a dry cereal crop, it spreads the harvest workload, and the sooner we can get another crop in."

Farming in a difficult area that's prone to flooding, he says he has sometimes lost parts of winter cereal crops. If lost areas have been reseeded with spring barley, it has been possible to harvest the whole crop for crimping, even if it's unevenly ripe.

Having used CrimpSafe 300 and its predecessor products as his preservation chemical for at least 10 years, he's found the feed has always stayed fresh and cool at the feed face and in the trough.

He says: "The clamp we're feeding now was made 11 months ago and is still in perfect condition."

He looks forward to adding crimping and dry grain rolling to his contracting services which already include cultivations, hay and silage-making including round baling, and combining. All at Kelvin Cave Ltd wish Colin and the family well in this endeavour.

Contact details for CV & EM Lewis & Sons and all contractors working with Kelvin Cave Ltd can be found on the contractors' page of the Kelvin Cave website.

Right: *Reserve champion bull, Garyvaughan Sammy is pictured with Terry Lewis at the annual North West Midlands and North Wales Limousin Club Sale.*

Feeding crimp to sheep improves health and cuts costs

Feeding crimped cereals and high-quality silage to ewes at lambing has cut out bagged feed and improved performance on a mixed Welsh farm.

Sheep and beef producers, Martyn and Gruff Jones turned to feeding crimped cereals to their sheep after three years of using the moist preserved feed for their beef. They'd seen how the home-grown product could cut out purchased feeds, improve animal health and ratchet up performance and hoped comparable improvements could be made in their 500 Welsh Mule ewes.

So, when they had a surplus of grain – brought about when they purchased extra land last year – they decided to crimp all they had grown, and then consider how best to use the additional feed.

"We could see we had more than enough crimp in the bunkers so we thought we'd look into feeding it to sheep," says Martyn, who was already equipped with a Murska 350 crimper and a Kuhn tub mixer he used for the beef.

Farming at Plas Onn Farm near Welshpool in Powys, the father and son team initially considered feeding a total mixed ration, so consulted independent nutritionist, Stephen Caldwell *(pictured left)* from SC Nutrition (UK) & Grass Science, to guide them with this switch.

But he said: "Successfully feeding stock comes down to 40% nutrition and 60% the practicalities of feeding, and I could see there wasn't enough feed face on this farm to feed the ewes a TMR."

Insisting a TMR requires enough trough space for all of the ewes to feed at the same time, instead he suggested feeding a crimp-based, home-mixed concentrate at up to 0.8kg/day (0.1kg/day for ewes bearing singles), and offering it with ad lib silage.

The plan was put into immediate action this spring and high-quality silage, preserved with Safesil Pro, and crimped wheat and barley, preserved with CrimpSafe 300, was fed to the ewes as they were housed around a month to five weeks before lambing. A 50:50 mix of crimped wheat and barley was mixed with a blend (comprising rapeseed meal, distillers grains and bespoke minerals) in a 60:40 ratio, and fed with buckets.

Lambing in batches from the first week of March, the ewes gained condition once they came inside and on to the ration. This made up for the difficult, dry conditions last summer and autumn when grass was in short supply, which had hit both ewe condition and lambing percent.

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"The ewes picked up really well on it, it cost far less than the bought-in nuts we were previously using – which have been as much as £380 a tonne – and we noticed they were really content," says Martyn.

"We also had far fewer prolapses – only four this year compared with 20 the year before – and although it's too early to attribute this to the new diet, we think it could have played a part," adds Gruff.

Considering this from a nutritional perspective, Stephen explains two ways in which the crimp was likely to be improving ewe health.

"Feeding 0.8kg of crimp creates less acid load in the rumen than feeding 0.8kg of dried rolled cereals, so improves the ewes' digestion," he says.

Furthermore, the smaller drop of pH in the rumen has a knock-on effect on the ewes' capacity to eat forage, which is higher after they've eaten moist crimp than dry grain.

"This has the effect of increasing forage consumption - something that's essential in achieving rumen fill and helping to avoid a range of problems, and that's likely to include prolapses," he adds, potentially explaining the substantial drop in cases seen this year on the crimp.

Above: *Gruff and Martyn Jones.*

Below: *Ewes and lambs at Plas Onn are benefiting from a crimp based blend.*

Also suggesting Martyn and Gruff had a better understanding of feeding stock under the new system, he said the quality of feed was also far higher than anything they'd previously purchased in the bag.

"A normal compound feed contains around 15 different ingredients, but all we have with this is four – two grown on the farm and all of known origin and high quality," he says.

The net result for the ewes was a concentrate with a metabolisable energy of 13-13.5MJ/kg DM and protein of 18-18.5%.

"Consistency is just as important as numbers and using these two Kelvin Cave products ensures the feed is of a consistently high quality," he adds.

This comes down to using chemical preservatives, which are the safest route to successful forage conservation and crimping, rather than bacterial inoculants.

Michael Carpenter, technical director for Kelvin Cave Ltd explains: "Both Safesil and CrimpSafe 300 are chemical preservatives so they directly inhibit undesirable microorganisms and give long-term aerobic stability.

"This is why farmers so often report stone cold forage and feeds when using either of these products," he says.

However, equally important – and related to these preservatives' efficient fermentation – is their effect on cutting dry matter losses compared with bacterial inoculants.

"Many inoculants on the market – those known as hetero-fermenters – work by ultimately converting sugars into acetic acid to stabilise the feed," he explains. "The inescapable by-products of this fermentation pathway are water and carbon dioxide.

"It is this pathway which is so inefficient and wasteful can cause high dry matter loss and inevitably increases carbon footprint," he says.

Also favouring the simplicity of the new ration, the Joneses note that the lack of shaking feed bags around the ewes also keeps the shed calm, and although they can no longer feed in the fields with a quad bike and snacker, the system encourages better checks to be made on the ewes and lambs as they're fed crimp from the bucket.

Michael adds: "Many people in sheep production just reach for the feed bag, which in some situations, can be the only option.

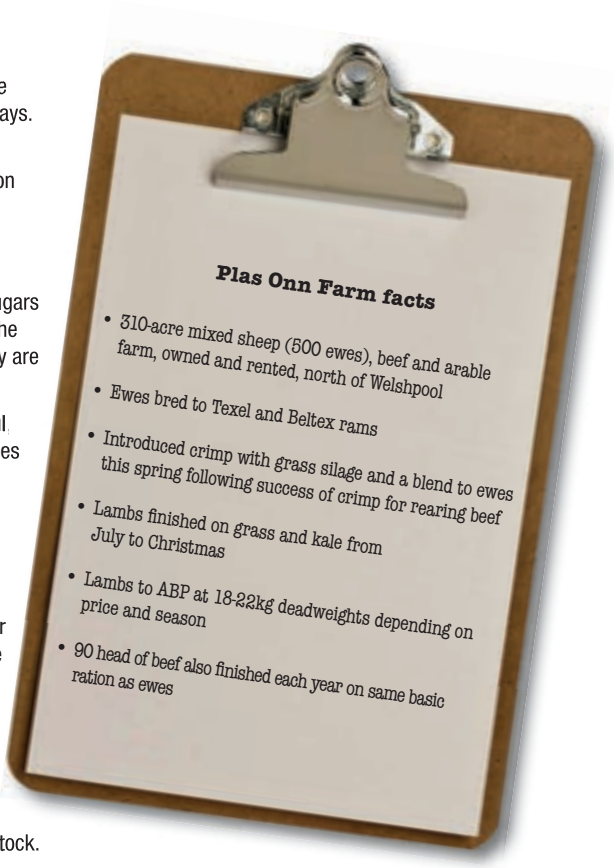
"They don't always realise crimp is such a good feed for sheep, even if they're using it to feed other stock.

"But in fact, using the same basic ingredients to feed sheep, with their own bespoke minerals, can create a really simple and cost-effective ration and method of feeding, especially for those who are already crimping for dairy or beef cattle.

"Furthermore, there's a growing interest in trading crimp from farm to farm which is very stable if correctly preserved," he adds.

Martyn and Gruff say the system suits them well and will be continued as long as they have enough crimp to feed.

"It's essential that we don't run out of crimp for the cattle as the business now depends on it, but we will crimp all the cereals we grow this year, which will extend to around 60 acres."



New project aims to cut imported soya use in half

Kelvin Cave Ltd is delighted to be working alongside PGRO with a consortium of industry, farming and research partners in a major, new initiative which aims to cut soya imports for animal feed in half and has been described as the 'defining project of our time'.

The drive to cut soya from livestock rations is at the forefront of many producers' minds but the lack of an evidence base to guide how best to achieve this has slowed down the switch to home-grown alternatives.

But that's all set to change as an ambitious new £5.9 million project, funded by Defra's Farming Innovation Programme and delivered by Innovate UK, is launched. It aims to slash farming's carbon footprint by increasing the UK's acreage of legumes in arable rotations four-fold, (to 20%), and developing and testing new home-grown protein feeds.

This two-pronged approach will help in this NCS (Nitrogen Efficient Plants for Climate Smart Arable Cropping Systems) project's aim of substituting up to 50% of imported soya meal used in animal feed with more climate-friendly, home-grown pulses and legumes.

And through these initiatives, the ultimate goal is to reduce the emissions from farming by a hefty 1.5 million tonnes (Mt) of carbon dioxide equivalent (CO_2e) per annum. This would make a substantial dent in the reduction targets already set for farming.

Kelvin Cave involvement

Aspirations of this kind have been a priority at Kelvin Cave Ltd for many years, and the company has been at the forefront of developing techniques for preserving a range of pulses for livestock feed.

But this ambition has been stepped up with the company's involvement with this NCS initiative where it will work with industry, farming and research partners with the project leaders, the PGRO (Processors and Growers Research Organisation).

"Everyone knows that pulses and legumes have considerable benefits for UK farming systems," says PGRO Chief Executive, Roger Vickers, who leads the NCS consortium. "But these have never been truly and accurately measured. So, their value has been sorely underplayed and their potential to address the climate crisis has gone unrecognised.

"Together we can change that. We now have the science, the tools and the know-how among UK farmers, not only to tap into that potential, but to develop it further. Bringing that talent together is what lies at the heart of NCS – it's never been done before, and there's never been a project on this scale with this much ambition."

Technical director at Kelvin Cave Ltd, Michael Carpenter, adds: "We have worked with PGRO over many years to champion increased use of home-grown or locally sourced proteins in ruminant diets and develop innovative solutions to processing, preserving and feeding them as we firmly believe this approach will not only improve farm profitability but also bring huge environmental benefits. So, we are absolutely delighted to have been invited to work with PGRO and other partners on this important project.

"Within the project, our company, supported by leading independent scientists, will focus on the harvesting, processing and storage of protein crops and will undertake trials ranging from forage harvester efficiency, comparison of current analytical processes to ensure accurate reporting of feed value, and additive efficiency trials for both wholecropped and combined legumes.

"Meanwhile, other partners within our work package will investigate processes including toasting and de-hulling and feeding these forms to all classes of stock."

These and other ambitions will be steered by science, but proven by farmers, through a series of paid-for on-farm trials and Kelvin Cave customers are urged to follow the company on social media where they will find links to the project pages.

The stages of the project

The first stage of the project will give 200 UK farmers direct support to establish their carbon baseline, using the Farm Carbon Toolkit. The greenhouse gas emissions from these farms will then be tracked throughout the project and will form a fundamental part of the data.

The leading innovators among participants will then be

paid to work with scientists to co-design crop and feeding trials to carry out on their farms.

These so-called 'Pulse Pioneers' will explore ways and means for soils to thrive, crop yields to build and livestock productivity to flourish, through better use and marketing of home-grown pulses and legumes.

The on-farm progress will be based on cutting-edge technologies and farming systems, incorporating some of the latest research and innovations from leading UK institutes and companies. These will be underpinned by rigorous use of data, including the UK's first ever full lifecycle analysis of cropping rotations and livestock systems.

How to get involved

Keen to expand the knowledge exchange beyond this core group of farmers, the project is also launching the PulsePEP (Performance Enhancing Platform), led by ADAS. This will be a discussion hub for the farmer-led community striving to achieve the best from pulse crops and to reduce carbon emissions.

The project team is urging interested farmers to sign up now, which they can do through the QR code above.

"This will be the defining project of our time," believes Mr Vickers. "It's not just the chance for UK agriculture to make a seismic shift towards Net Zero, but it'll also deliver a prosperous and resilient way of farming for communities worldwide.

"We want farmers to join us and be part of this exciting journey of discovery. Your knowledge and experience will enrich the science we're bringing together. You will inspire others and accelerate the pace of change. And together we'll achieve a farming future that is richly rewarding and immensely gratifying."

More information about the project, including links to project partners and research initiatives that underpin the project can be found at **ncsproject.co.uk**

NCS - the figures explained

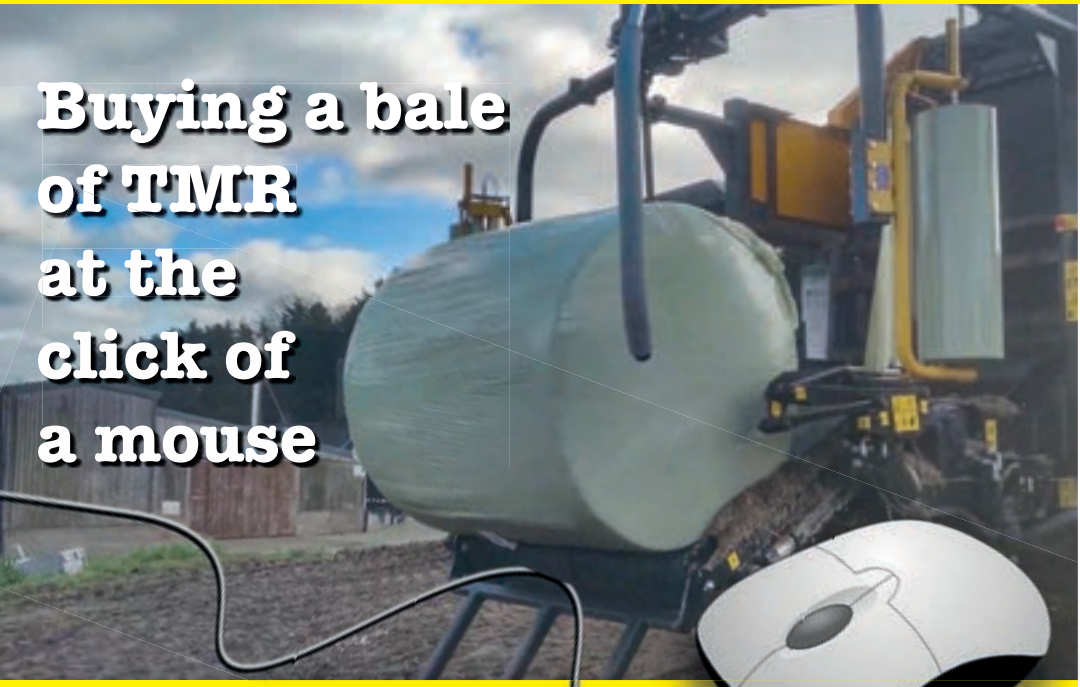
The annual reduction in CO_2e emissions of 1.5 million tonnes can be achieved through:

- Increasing pulse and legume cropping areas to the rotational optimum of 20% (1M ha) across UK farms. This would reduce nitrogen fertiliser use by 233,000t, resulting in 0.55M tonnes CO_2e reduction.
- Using the subsequent produce in animal feed, replacing 50% of imported soya meal and delivering a further 0.7M tonnes CO_2e reduction.
- The residual nitrogen benefit to following crops through soil enrichment, leading to an additional 0.25M tonnes CO_2e reduction.

Participants and funding

- PGRO (Processors and Growers Research Organisation) leads the consortium which includes AB Agri, ADAS, Agrii, BOFIN (British On-Farm Innovation Network), Cranfield University, Farm Carbon Toolkit, Firstmilk, GWCT (Game and Wildlife Conservation Trust), The James Hutton Institute, Kelvin Cave Ltd, LC Beef Nutrition, LEAF (Linking Environment and Farming), McArthur Agriculture, PBL Technology, SRUC and Wessex Water.
- The NCS Project is funded by the Farming Futures R&D Fund: Climate smart farming, part of Defra's Farming Innovation Programme. Defra are working in partnership with Innovate UK who are delivering the programme.
- The project is one of more than 50 cutting-edge farming projects receiving a share of £30M, announced by Defra on Wednesday, 31 May.

Buying a bale of TMR at the click of a mouse



Innovative thinking by a Herefordshire farmer has led him to produce high density bales of a total mixed ration which can be purchased online and delivered by pallet.

The practice of buying goods online has made its way into virtually every corner of modern life. But what about total mixed rations? Is it possible for a TMR to be compacted into bales and delivered on farm – even on a single pallet – at the click of a mouse?

Emphatically yes, according to Herefordshire farmer, Stephen Ware, who has devoted a lifetime of farming to innovative thinking and diversifying his enterprise, which now includes an e-commerce site through which farmers can buy bales of a compacted TMR, alongside apples, cherries, pears and crimped and wholecropped cereals.

Farming around 300 acres (121ha) at Throne Farm near Weobley, growing and making the TMR is part of a web of interwoven farming operations, many reliant on the other, and each adhering to sustainable principles on this mixed farm. As such, Stephen is rebuilding the heart of the farm on which he follows his father and grandfather, merging its historic virtues with the regenerative farming practices he's been following since 2010.

Today, he is moving away from monocultures – whether of wheat or barley or orchards – and integrating farming practices to create a more circular business, where the risks of growing a single crop or selling to a single buyer, have been largely removed.

At the heart of this system is agroforestry, created by a combination of fruit tree plantings (20,000 in 2017) and reconfiguring large swathes of intensive cider orchards by removing most of the trees but retaining every fifth row. Between the trees, sheep may be grazed or pulses or cereals grown, either used as part of the TMR or baled as wholecrop and sold off the farm.

"We've been introducing diversity," explains Stephen. "Air and light around the trees mean they're less of a target for pests and disease, so we need fewer pesticides."

And contrary to conventional wisdom – that tree roots reduce the nutrients available for the arable crop – he says the opposite can be true.

"In a standard arable system, the highest yields are expected in the middle of the field but in this system, the highest yields are at the edges," he says, explaining how there's increasing reliance on soil structure and biodiversity as inputs decline.

"When we tested in 2012, early in our regenerative journey, we had a deficit of fungi in the soil. This suggests the trading platform between the bacteria, fungi, protozoa and the crop was broken," he says.

Setting out to rebuild the health of the soil, he also had to cut back on inputs, most notably phosphorus. This ad been built up over decades of poultry farming and spreading poultry manure – a practice now significantly reduced.

Growing ingredients for the TMR fits with all the farm's principles, while preserving the ration to the highest possible standard is an essential part of the de-risking process and ensures buyers have confidence that every bale will be as good as the last.

Ingredients in each high-density bale – compressed in an Orkel Hi-X baler, originally used to compact chicken manure – include crimped wheat, wholecrop beans, sugar beet pellets, wheat straw and molasses, with beef finisher minerals, limestone flour and Actisaf live yeast.

Noting that the crimp is an integral part of the ration, Stephen says he values the crimping process on several levels.

Above: *Stephen Ware takes to his throne at Throne Farm.*

Below and far left: *The Orkel Hi-X baler was originally used to compact chicken manure but now produces high density bales of TMR, each weighing over one tonne.*

"I started working with [feed and forage preservation specialists] Kelvin Cave Ltd around five years ago, having been very taken with the process of crimping," he explains.

Particularly keen on the early harvest, he liked the fact that the crop was less mature and retained more of its nutrient value than a dry crop of cereals, but he says: "I soon worked out that an equally important benefit was the shorter growing season.

"It gives us more flexibility, although it requires an open-mindedness in our contractor," he says. "We learned a new set of principles and Kelvin Cave Ltd were very good at advising and we had Michael Carpenter [Technical Director], to guide us through the process."

Often finding himself able to gain an extra catch crop - even for as little as eight weeks between harvesting crimp and sowing winter cereals – this helps meet his ambition of keeping his ground under vegetative cover at almost all times.

Spring beans for wholecropping as another component of the ration have the further benefit of bringing nitrogen into the soil from the natural, fixing process.

The resulting total mixed ration analyses at a dry matter (DM) of 57%, protein 14.4%, starch 37.3% and metabolisable energy (ME) of 11.8MJ/kg DM. Formulated by a professional nutritionist, it is projected to achieve liveweight gains of 1.46kg/day for bulls and 1.35kg/day for steers.

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Alternative rations can also be created for sheep and dairy producers.

Admitting to the need for a certain mindset amongst customers in buying a baled product for over £200 a tonne, he says: "It's not comparable with a bale of hay or silage; it's nutritionally matched to a compound feed – although better for the animal's digestion – and weighs over a tonne per bale."

A weighbridge has recently been installed for known weights to be purchased, while the high quality of product is said to be mirrored in animal health and performance, both of which are confidently predicted to benefit from the ration.

"Any ration containing a high component of quality forage is beneficial to ruminant digestion but the crimped cereals add a further dimension," explains Michael Carpenter.

"Crimp is both safer for the rumen and more digestible than dry rolled grain. It can therefore be fed in higher quantities, without the risk to rumen health that comparable amounts of dry cereals would bring," he says.

The quality of both the crimp and wholecrop beans is ensured by the choice of preservative used in their production, which reassures buyers of the keeping quality of the TMR.

Additives for both the wholecrop beans and the crimped cereals are salts-based chemical preservatives – Safesil Pro for the beans and CrimpSafe 300 for the crimp – chosen for their proven ability to remove risk from the process.

"These products work by eliminating harmful bacteria and ensuring that a favourable fermentation quickly preserves the crop with the least possible loss of nutrients," explains Michael. "Once the bale of TMR is opened, buyers can be assured it will have excellent keeping qualities on exposure to air, allowing livestock to feed straight from the bale without the risk of heating and spoilage."

This is assured by the ingredients contained in Safesil Pro and CrimpSafe 300, both of which include preservatives licensed for use in human food.

Stephen says he finds customers for his bales are far more discerning than in the past, and increasingly understand what specification of feed they need and the value of the ration.

Buyers include a cross-section of livestock farmers, from small-scale producers who don't have any mixing facilities of their own and may even buy a single bale on a pallet, to larger producers who may buy a load when their own feed runs low.

"A particular attraction is for small producers who can benefit from the type of TMR feeding – with all its virtues for rumen health and livestock performance – they may not have previously had at their disposal, without the equipment or maybe even the labour to create the ration," adds Michael.

Stephen's customers also appreciate the low food miles and carbon footprint of UK farm-grown produce, many support his regenerative approach to farming and all of them enjoy the benefits of removing the middleman by trading from farm to farm.

Compacted TMR bales for farm-to-farm trading

- Compressed by Orkel compactor baler to average weight of 1.036 tonnes/bale
- Approx price of £212/tonne, dependent on size of order
- Sold by the bale or tonne, from one bale on a pallet to a lorry load
- Include crimp, wholecrop beans, sugar beet pellets, molasses, minerals and yeast
- Analysis: DM 57%, protein 14.4%, starch 37.3% and ME 11.8MJ/kg DM
- Crimp preserved with CrimpSafe 300 and wholecrop beans with Safesil Pro

Below: *Stephen Ware grows arable crops between rows of fruit trees. Here, he harvests wheat for crimping.*

Fattening beef on bought-in bales of TMR

Above and inset: *The cattle performed well on high-density bales of TMR, labour was minimal and waste was said to be nil.*

Like so many livestock producers, Henry, Esther and Monty Rudge were hit by last summer's drought followed by a cold and wet spring.

So, with low forage stocks and difficult conditions for turnout, they opted to buy bales of Stephen Ware's total mixed ration *(see opposite)* to finish their forward stores inside, instead of at grass.

Producing around 100 finished cattle per year on their 320-acre (130ha) mixed farm at Ballingham Court near Ross-on-Wye, a batch of 26 head was put on the ration this April.

Four weeks later, the first group of 12 were ready for sale. Having started at an average weight of 540kg, they had gained an average 1.5kg/day and killed out at an average deadweight of 285kg. The average age of these Hereford x Stabilisers was 14 months.

Henry says he has been extremely pleased with the performance of the stock on the TMR as well as the feed itself – both its nutritional and keeping quality – and the ease with which it can be fed.

"We just open the bale on the concrete and scoop it with a bucket and into a trough," he says.

"When we started, they were eating it slowly and it had to last for around 10 days," he says. "It did this comfortably, and there was no heating and the waste is nil.

"The cattle also look fantastic on it and we notice they lie down and cud a lot which is a sign they're comfortable."

Asked about any concerns in using a newly conceived product, he said: "We have used Kelvin Cave products in the past and that was one reason we were so confident this would work.

"All the products we've used do what they claim they're going to do so we had every confidence in giving this a try."

Also stating that the ingredients in the ration perfectly meet the requirements of his supermarket buyer, he says they want no GM soya and prefer the ingredients to be locally sourced.

He adds: "We had crimped grain in the past but with just 100 finishing animals, a clamp of 500 tonnes would be too much."

He also cites the convenience factor of buying the ration as and when it's needed, giving them complete adaptability to do as required with minimal labour and absolutely zero waste.

KC SiloBond is a multi-purpose agricultural spray adhesive specially formulated to bond silage sheets together or attach them to the clamp walls.

This makes hanging side sheets easier and safer, and reduces the risk of damage when filling, as well as providing a better seal on the clamp shoulders and joins, saving plastic by reducing the size of the overlaps.

SiloBond can also be used safely on a wide variety of surfaces around the farm and home.

A 500ml can will bond around 35 linear metres of sheeting with a 20cm seal.

Dates for your Diary

Come and see us at any of the following events during 2023:

21 June
Down to Earth
Rushywood Farm
Haselbury Plucknett
Somerset

22-25 June
Royal Highland Show
Royal Highland Centre
Ingliston
Edinburgh

6 July
Down to Earth
Park House
Torpenhow
Wigton
Cumbria

24-27 July
Royal Welsh Show
Royal Welsh Showground
Llanelwedd
Builth Wells
Powys

For more information about anything featured in this issue of *KnowHow*, please don't hesitate to contact us by phone or email, or go to our website.

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