A Nuffield Farming Scholarships Trust Report

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UK beef and lamb:

making the grass greener on your side of the fence

Niall Armstrong

July 2014

NUFFIELD UK

NUFFIELD FARMING SCHOLARSHIPS TRUST (UK)

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A Nuffield (UK) Farming Scholarships Trust Report

Date of report: July 2014

"Leading positive change in agriculture. Inspiring passion and potential in people."

Title	UK beef and lamb : making the grass greener on your side of the fence.
Scholar	Niall Drummond Armstrong
Sponsor	The Worshipful Company of Butchers
Objectives of Study Tour	• To better understand what the future of the UK beef and lamb sectors holds • How can beef and lamb producers reduce exposure to increasing global influences on inputs • To better understand how to utilise grass in beef and sheep systems for improved profit
Countries Visited	UK, Ireland, USA, New Zealand, Australia, Brazil, Uruguay, Paraguay
Findings	• There is a lot we can do in the UK to better utilise grass, the most economic feed available in most parts of our country • The UK has a higher fixed cost structure than any other country I visited • Work is being carried out to identify and improve more feed conversion-efficient animals • There is opportunity to improve beef cattle and sheep efficiencies (weaned weight/maternal weight) • Other countries do a lot more finishing from grazed grass than we see in the UK • In many other countries, different areas focus primarily on what they can do well

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DISCLAIMER

The opinions expressed in this report are my own and not necessarily those of the Nuffield Farming Scholarships Trust, or of my sponsor, or of any other sponsoring body.

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1. My introduction

Farming is my passion and it has always been my ambition to secure a future in the agriculture industry. It came as no surprise to my parents when I decided to head off to the Scottish Agricultural College in Edinburgh and, after completing a degree with honours, I returned home to the family business in 2005. I am now fortunate enough to be a third generation farmer at Kirvennie Farm, in the Machars area of Wigtownshire in Dumfries and Galloway, Scotland.

Me, Niall Armstrong

Since the unexpected passing of my father Gordon in 2007, the business structure here is that of a family partnership where I work alongside my mother, Caroline, and my brother, Graham.

The business here has evolved rapidly from being involved in excavation and housing to now solely focusing on agriculture. At this present moment in time we are producing beef, lamb and free-range eggs along with some electricity generation from three 15kw/h wind turbines.

In 2011 we sold all our dairy-cross and continentally-bred cattle and now base our herd on spring calving Aberdeen Angus x Hereford cows, which we cross back and forth to these respective breeds to maintain hybrid vigour. This allows us to produce beef animals that are easy fleshing on a grass and forage diet from cows that get back in calf. After initially purchasing high quality genetics of this makeup we are now in a position to breed our own heifer replacements which we calve at two years of age. The other progeny of our currently 90-cow herd is sold live as 18-month-old forward stores before their second winter. All calves are wintered on brassica crops and, as genetics and grassland management improve, my goal is that soon I shall be closer to finishing these animals at the same age from grass.

We run a sheep flock of 1000 breeding ewes that until 2012 were all Scotch Mule bred to Texel sires. Since then we have been phasing in Romney genetics with a view to breeding

our own replacement females that are more readily adaptable to the system that we want them to perform in, whilst producing good quality finished lambs from grass. Weaning takes place at 100-110 days of age for the lambs and at this stage replacement females are selected for mating as ewe hoggs. The majority of our lambs are sold straight to processors on a deadweight basis although 100-150 lambs reared from a salt marsh area of land we lease are sold to local butchers.

In addition to our beef and lamb producing enterprises, since November 2010 we have been producing free-range eggs from 32,000 Isa Warren hens. Although layer hens have been a very new learning curve and brought about different challenges compared with those of managing cattle and sheep, the experience gained by us all has been rewarding. The enterprise has integrated into our business well and allowed us to utilise our labour resources whilst reducing artificial fertiliser costs through the use of the manure produced.

Me with maiden black baldie heifers at Kirvennie

2. Background to my study topic

The farming business we operate runs without a Single Farm Payment, which is what the current subsidy support scheme in Scotland is known as. In some ways this has been a disadvantage but in more ways, I think, it has become an opportunity in that it has necessitated change to improve profitability and our business as a whole. In a metaphoric sense I was increasingly finding the grass greener elsewhere and wondering what we could do to make things better and, looking back, we couldn't really afford *not* to change and of course there is the old saying….

> *"If you always do what you've always done, you'll always get what you've always got*"- Henry Ford

With so many uncertainties surrounding our business's future prospects, in early 2009, with some encouragement from my brother and business partner Graham, I made the decision to go to New Zealand's South Island to learn more about the unsubsidised farming systems there. Having had a limited idea of what to expect over there I returned home feeling truly inspired by the attitude of the people and the way that they had adapted their systems to survive after their agriculture support was removed in 1984. I had kept a portfolio of the farmers I had visited in 2009, and was presented with the opportunity to experience working in a South Island, New Zealand, winter. So in 2010 I returned to work at the Hargreaves family's beef and sheep unit, Kakahu Station.

I had wanted to return during their winter as I saw the real challenge in their systems as being the management of stock feed demand through the seasonal trough of grass and forage growth. I managed to squeeze in two months there around commitments back at home and, fortunately for me, it was their wettest winter and spring in a decade, which reinforced to me the relevance of applying principles of that system back in Scotland!

We subsequently changed the genetics of both the cattle and sheep within our own farming business - as I alluded to in my introduction. However, it was still all the more apparent that there was a lot more to do than simply change animal genetics to improve our profitability. This pointed me in the direction of applying for a Nuffield Farming Scholarship to really drill into the details.

There are and always will be many challenges facing our beef and lamb sectors and we have experienced record prices for produce within the last year but, at the same time, costs of production are higher than ever. Worldwide demand through a rising population and expanding bio-fuels industry along with unpredictable weather patterns have inflated costs to unprecedented levels, whilst fuel and fertiliser prices have also been nearer the top end of our experience.

Among many areas of reducing costs within the parameters of my own farm boundary, of particular interest to me was learning how farmers manage grassland to maximise utilisation and quality to improve their bottom line. I wanted to discover what I could do to adapt our system at home to reduce our exposure and in doing so learn the nature of the challenge we as beef and lamb producers are up against. Can we literally and metaphorically make our grass greener for a more sustainable business model?

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I totally appreciate that every farming situation has a different set of challenges and, as well as us all having different outlooks and aspirations about what we want from farming, there are also physical factors like breed, environment, climate and land type to consider.

For these reasons I hope you find some relevance and interest in reading this report. To the Nuffield Farming Scholarships Trust and my sponsor the Worshipful Company of Butchers: I am indebted to you for this incredible opportunity.

First calved black baldie heifers in fog at Kirvennie

3. Who, what, when where, why?

Early on in the planning of my travel itinerary I made the decision to gain a better understanding of the beef and lamb sectors on my own doorstep before I started to travel the world looking for answers. Most of my meetings involved getting onto farms and research institutions but I also managed to factor in attending some conferences which, in life prior to my Nuffield Farming Scholarship, I had not managed a lot of.

I would like to start in this section by broadly summarising where I went and whom I would like to briefly acknowledge from those experiences. I mean briefly because I will probably never be able to justifiably sum up in my own words the gratitude I feel towards these people for the time and consideration they selflessly allowed me.

The memorable Contemporary Scholars Conference in Ontaria, Canada in March 2013 was followed by probably the most challenging spring in my farming experience. I kicked off the personal study part of my Nuffield Farming Scholarship in the summer of 2013. Some of the most interesting and influential people I met and places I saw deviated slightly from my subject of study but I will not mention and go into detail on every single visit paid; rather I will try to keep what I describe relevant to my study topic.

I chose to visit the following countries – which, as you can see, included the UK:

COUNTRY	DATE OF VISIT	REASON FOR VISIT
UK	July and August 2013	I wanted to gain a better understanding of where we were in the UK with our beef cattle and sheep grazing management and techniques before heading further afield.
Ireland	September 2013	My perception of Ireland was that of having lower input, higher output, grass-based beef and sheep systems and I wanted to learn what makes the difference in a country with such a similar climate to our own.
USA	October 2013	With consistent conditions in large scale feedlot finishing beef operations the USA is doing a lot to improve feed conversion efficiency. I wanted to explore the potential benefits of such.
New Zealand	November 2013	Intensive grassland management for profitable and sustainable beef and lamb production with no subsidy – what are the key elements?

Australia	December 2013	Large-scale beef and sheep production in an adverse climate. Learning how in Australia they manage livestock around such variable growing conditions.
Brazil	February 2014	Exploring the beef giant that is Brazil to better understand what the future may hold for a country with such massive potential.
Uruguay	February 2014	Learning about Uruguayan grass-based beef production with established high quality export markets.
Paraguay	February 2014	To learn about low cost beef production and experience the emerging potential of Paraguay, a country with one of the fastest growing beef herds in the world at present

Romney ewes with young lambs at Kirvennie

4. UK

It all began with a trip down to the south of England where, through some assistance from Liz Genever of the English Beef and Lamb Executive, I attended some sheep grazing discussion group meetings. I was fortunate enough to then meet a Kiwi beef and sheep consultant by the name of John Scandrett, and also to catch up with sheep specialist John Vipond whom I hadn't seen since my time at the Scottish Agricultural College (SAC) in Edinburgh.

I had a bit of a light bulb moment during this trip when what I could achieve in my own system with a bit of knowledge and application started to sink in. It dawned on me that one of the greater areas of challenge I had faced with my sheep wintering had been created by giving our ewes what they "wanted" from mating onwards as opposed to what they "needed". Thus I was grazing off all my grass covers leading into winter and leaving myself short of feed on the way out, at a time when the ewes' feed requirements were increasing from mid pregnancy onwards. This was creating a feed deficit that had to be made up with supplementary feeding which increased our costs.

… one of the greater areas of challenge I had faced with my sheep wintering had been created by giving our ewes what they "wanted" from mating onwards as opposed to what they "needed".

With the conversations I heard during this south of England trip on the topic of rotational grazing I became excited by the prospect of reducing wintering costs at the same time as ramping up production in the summer, all through improved management of grass. The influence of having key performance indicators, which I will touch on later in my report, also became very apparent. By this point, a key message was starting to do the rounds in my mind as time and time again it was reiterated that: *if you don't measure something, how can you manage it?* The question to me was whether I was measuring enough at home? The answer: probably not.

if you don't measure something, how can you manage it?

As well as this trip within the UK, I had several others that were of significant impact in gaining a good insight. One in particular was a trip to meet Ursula Taylor from the Stabiliser Cattle Company and Davy Thirlwell, Herd Manager at JSR's Stabiliser cow herd at the Stabiliser Cattle Company's Givendale Farm, Givendale in East Yorkshire.

The Stabiliser breed makes fantastic use of hybrid vigour with a 4-way composite breed of Angus (red and black), Gelbvieh and Simmental. At Givendale I visited and learned about the net feed efficiency (NFE) project being carried out which as far as I know is the only centre of its kind in the UK. Now that the first few batches have been through the Growsafe units

since its beginning in January 2012, a clear picture is being formed detailing how much more feed-efficient animals can achieve for the beef industry both economically and environmentally. Huge steps are being made at Givendale Farm with the development of genetics from both the UK and those of imported bloodlines from the USA. Whilst backed up by research data from the NFE project, I found the Stabiliser herd at Givendale's breeding programme to be very interesting also, particularly with their emphasis on birth weight and mature cow weight all contributing to their focus on improving profitability. The future lies in these animals and, through the use of gene markers, identifying the genetic make-up that contributes towards their feed efficiency.

After this, in the September of 2013 I took the opportunity to travel 30 minutes along the road from home to hop on the ferry over to Northern Ireland. With the help of Neville Graham, a senior beef and sheep technologist with CAFRE (College of Agriculture, Food and Rural Enterprise) I was able to see and learn what best practice is like over there.

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During my visit to Northern Ireland, I spent time with some of their more efficient producers where, with a smaller average farm size compared with that of Scotland and England, I was impressed with just how well they utilised the land available to them. With an average suckler herd size of twenty cows and an average ewe flock size of just over one hundred ewes, producers in Northern Ireland are certainly focused on achieving optimal production from the generally smaller areas of land available to them.

Many famers deal with fragmented land parcels, which largely stem from a historically high land price plus the conacre[1] letting structure. Although limited by this factor the farmers whom I visited were very focused on maximising their output per hectare whilst achieving a very close control of their costs.

By and large I believe that a primary reason contributing towards this focus on output and cost control was through a benchmarking service provided to Northern Ireland farmers by CAFRE. Those benchmarking had slightly larger holdings than the average size but this service, at no cost to the farmer, has brought about a method of evaluating and comparing both physical and financial performance of farm businesses with other similar farm enterprises in order to identify areas where that business could be improved to increase profitability. I had come across benchmarking before and, through the beef and sheep group I am a member of within my own home area, we have benchmarked in the past but not on a scale like what is happening in Northern Ireland and the Republic of Ireland, as I went on to discover.

[1] A system of letting land, usually for 11 months.

In addition to getting on farm in Northern Ireland I was also able to visit the AFBI (Agri-Food and Biosciences Institute) Loughgall plant breeding division in County Armagh along with their research centre near Crossnacreevy. At Crossnacreevy I met a fellow Scot named Scott Laidlaw who is a grass researcher there and controls the "Grasscheck" monitor plots that are run on active farms. Information from these plots is published weekly so that farmers can access grass and clover growth data in and around their area, allowing them to assess their own progress and make alterations to suit. This provides an invaluable tool for farmers for their day-to-day decision-making.

Yet with all these improvements (in grass and clover varieties) I don't think there has been the same change or steps forward, in a grazing context, in the way we have managed our swards during the same period of time.

My visits to these institutions really opened my eyes to the hard work carried out and money invested over the last number of decades in improving grass and clover varieties. Yet with all these varietal improvements, I don't think there has been the same change or steps forward, in a grazing context, in the way we have managed our swards during the same period of time.

Net feed efficiency bunkers at Givendale Farm in East Yorkshire

5. Ireland

From Northern Ireland I travelled south into the Republic of Ireland and, through contacts within Teagasc (pronounced Chawgask and is Gaelic/Irish for teachings/learnings), which is their Agriculture and Food Development Authority, I was able to start to gain a better perspective of what they are doing there.

My first visit in Ireland was to the Athenry Animal and Grassland Research and Innovation Centre, near Galway on the west coast. Here I met with Anne Kinsella, an economist who gave me an introduction to the current state of affairs with particular reference to their sheep industry. Anne highlighted to me the massive gulf in profitability between the top, middle and bottom third of lowland sheep farms in Ireland. When the top third of producers are achieving a gross margin of over €900 per hectare and the bottom third are realising just over €200 per hectare it is clear to see that, through knowledge application, there exists an opportunity for improvement.

Included within this research analysis was an assessment, which showed a high correlation between profit from sheep and land quality. However, alongside land quality, Anne said that stocking rate is another primary factor in delivering higher gross margins as the top third are carrying nine ewes per hectare compared with seven ewes per hectare as the overall average for all farms, and five ewes per hectare in the bottom third.

Another factor suggesting that profitability on these farms is not all attributable to land type is that a lot of the top performing producers have a higher cost structure than those in the lower brackets **but** are managing to gain more from their money spent. As I went on to learn in other countries, there is a big difference in profitability between producers, and it can often be linked back to management type as opposed to any other limitations.

What I found most interesting in Ireland was what their government have done/are doing to incentivise knowledge uptake by producers.

What I found most interesting in Ireland was what their government have done/are doing to incentivise knowledge uptake by producers. A state funded scheme was being run at that time - and may have changed by now - but they were making a €1000 payment available to producers in return for them attending five discussion group meetings per year. As well as attending the meetings these farmers were required to enter their financial performance figures into a profit monitor database whereby, like the Northern Irish system, they are able to gain feedback, benchmark their results, and discuss key business decisions with a consultant concerning the year ahead.

Whilst at Athenry I met with Philip Creighton who is carrying out research to develop profitable and sustainable pasture based systems of sheep production. The basics of the

trials are that they are comparing medium prolificacy ewes (1.5 lambs weaned/ewe) with high prolificacy ewes (1.8 lambs weaned/ewe) across stock rates of ten, twelve and fourteen ewes per hectare with a focus on the effects of stocking rate and prolificacy on grass supply and demand, plus lamb performance at pasture.

Varying degrees of performance in the different areas of research are being identified and I found it particularly interesting to note that the high prolificacy ewes at the highest stocking rate were not necessarily achieving the highest output per hectare. Philip explained that every farm has an optimum output for profitability and how essential it is for every farmer to identify, through careful analysis of their figures, what this is for him/her. Agreeably, this target level of output may vary from year to year but we as producers need to be aware - when pushing production up - that we are not dragging up our costs of production at the same rate.

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In Ireland, a project called the BETTER farms programme is operated and this involves applying research-based recommendations to a farming system where the results can be measured and demonstrated at a local level. The outcome and benefits of such research are evaluated in terms of how practical they are to apply, along with the impact that they may have on the farm business's efficiency and profitability. Research demonstration farms and BETTER farms are then benchmarked against one another to continue the progress from year to year. I was fortunate enough to be able to meet a number of farmers involved in the BETTER farms programme during my time in Ireland and, given our scale advantage in the UK with the opportunity to spread fixed costs over increased output, I would say the potential for improvement with modernised grassland management is significant.

After travelling through the heart of Ireland on my way back north I dropped in to The Grange, Teagasc's main beef research centre in the country. I had the good fortune to gain an insight into the work of researchers there. It covered topics such as economic analysis, ruminant nutrition, feed efficiency, animal growth rates and silage production and utilisation. In an export-orientated country where beef exports are worth 2.1 billion euros to the economy and dairy exports over 3 billion euros, it is interesting to note that this income comes from 100,000 beef farmers and 15,000 dairy farmers - albeit half of the beef export is dairy sired. With Ireland aiming to lift milk production 50% by 2020 - once the milk quota restrictions are lifted in 2015 - it creates in my mind a significant opportunity for dairy-beef production as a viable alternative for producers who may be failing to make a profit keeping suckler cows.

6. U.S.A. – Nebraska, Colorado and Oklahoma

I flew into Omaha, Eastern Nebraska, on September 30th, 2013, and from there hired a car and drove west through corn country towards the University of Nebraska in Lincoln. The main reason I wanted to visit some of North America was, in addition to gaining a better overall global perspective on agriculture, I wanted to learn more on net feed efficiency in beef cattle. The pig, poultry and dairy sectors are decades ahead in their genetic gain and efficiency (largely due to their controlled feed and environments I know) but globally pork and chicken consumption is rising as beef and lamb consumption declines. This is largely price driven and I believe that one of the ways we can become more competitive in our cost to the consumer and to the environment is by reducing feed conversion rates. It is amazing to hear of DMI:weight gains of 2/3:1 in pork and poultry where in the beef industry I would suggest we range from 5:1 to more than 20:1 depending upon the health, stage of life cycle the animal is at, and the quality and availability of feed present. I am not suggesting we in the beef cattle and sheep sectors should go down the intensive route like the pig and poultry sectors but I believe there lies huge potential for improving feed conversion efficiency in ruminants from grass and forage.

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I met Dr. Terry Klopfenstein and Dr. Jim McDonald on October 1st amidst 27°C heat which was a bit of a novelty in October for me. Nebraska is currently number two in the States after Texas for finishing cattle numbers. Main agricultural output for Nebraska is corn (maize), beef and ethanol although a lot of wheat and soybean is also grown, mainly as a break in the corn rotation. A recent severe drought in North America has drastically affected cow numbers in other States such as North Dakota, South Dakota, Wyoming, Montana and Kansas. Nebraska now has between 1.8 and 1.9 million beef cows, which makes it the 2nd largest cow herd in the United States and four times larger than that of Scotland. In 1976 there were 45 million beef cows in total in the States. This number has reduced steadily since then to approximately 29 million, but actual beef output has remained close to the previous level representing more efficient production.

The US government are currently pushing corn ethanol and cellulosic ethanol production by subsidising producers and, while this is producing a lot of by-product used for feedlot finishing of cattle, it is creating land use competition with the grassland required by the beef cow sector. Crop residue after harvest represents an opportunity for the cow calf operators to use as a cost effective wintering tool, but corn farmer attitude is very wary about compacting ground in wet weather. The flip side of this of course is the benefit of the fertility added to the ground, and in high yielding crops with more residue, it may allow for a better seed-to-soil contact at sowing.

The following day I was supposed to spend two days at the United States Meat and Animal Research Centre near Hastings but unfortunately due to a US government shut down this was cancelled the day before my meeting. So from here I wound my way across Nebraska, meeting beef producers and learning about the challenges they face within their systems.

My final meeting in Nebraska was over in the west of the State near Scottsbluff with Hereford breeders Doug and Art Olsen of Olsen Ranches. The Olsen family run a herd of 1000 Hereford cows on over 4000 hectares of rangeland native grasses, as well carrying out 1700 hectares of cropping which includes corn, wheat, beans, millet, forage oats, turnips and radish. Twelve centre pivot irrigators aid all this production as, whilst groundwater seems to be plentiful in much of Nebraska (70% of their corn is irrigated), rainfall is little over 300 millimetres per annum in this area.

At Olsen ranches they have installed 24 Growsafe Net Feed Efficiency bunkers, which are in banks of four allowing the operation to be processing six trials at any one time. Hereford semen within the top percentiles of the breed is used over their cows, and progeny from different sires are performance recorded through the Growsafe system. The American Hereford Association are collating all this data and using it towards improving the breed. Sires are used at random over what I can only describe as an exceptional herd of Hereford cows and in the 2012 trials one group showed a positive net difference of $100 USD compared with that of another group. We all know that there is as much difference *within* a breed as there is *across* breeds but, bearing in mind that these cattle are performance recorded and at the top of their breed, this makes for quite an astounding comparison.

Herefords at a water trough on Olsen Ranch, Nebraska

After my visit with the Olsens I headed south towards Denver to meet Lee Leachman at Leachman Cattle of Colorado, based at Wellington. They market and sell 1000 bulls and 2000 females annually. Lee was able to take the time to talk me through the operation there where they co-operate with 35 breeders in control of 6500 cows to supply quality genetics to the US and overseas markets. They have been involved in supplying genetics to the Stabiliser Herd at Givendale that I mentioned earlier in my report (*see page 7*) and, as far I'm aware, Leachman genetics form the basis of the UK Stabiliser breed. All the bulls sold through Leachman's are performance tested through the company's facilities before being sold on for commercial production. The pool of genetics under Leachman's umbrella is incredible and again, having created an Expected Progeny Difference (EPD) for $profit they are industry-leading in genetic progression. I was interested to learn of the emphasis on moderate mature size within their breeding programmes and that they specialise in both maternal and terminal bloodlines. Lee was able to tell me that in 10 years' time the average feed conversion rate for the bulls Leachman Cattle of Colorado sell will be 5:1. At the current time their best bulls are doing 4:1.

After a few more visits in Colorado, my last stop in North America was further south again, down through Kansas and into the State of Oklahoma where I had the privilege of visiting the Noble Foundation at Ardmore. Oilman and philanthropist, Samuel Lloyd Noble formed the Noble Foundation in 1945 through recognising the importance of sustainable agriculture to future generations.

> *"We believe that while at times we have felt the overshadowing presence of oil, we are living in an area that is essentially agricultural…The land must continue to provide for our food, clothing and shelter long after the oil is gone*." – Lloyd Noble

For this era, in the aftermath of the dust bowl of the thirties that particularly affected Oklahoma, the significance of Lloyd Noble's foresight was timely. Today, through the Foundation's Agricultural, Plant Biology and Forage Improvement Divisions, science and research is taken from their laboratories and applied on farms thus improving agriculture in Oklahoma and farther afield. During my visit I met with Dr. Charles Brummer of the Forage Improvement Division as well as spending some time out on research and private farms with ag consultants, James Rogers and Hugh Aljoe. Noble Foundation has eight research farms comprising a total of nearly 5300 hectares. On one of these farms an interesting trial currently being carried out is measuring performance in finishing steers at grass. A major advantage that the dairy industry has over the beef industry is that production performance is measured twice a day, every day, in the milking parlour. In this particular grass based trial, through the use of electronic identification and a weighing system, cattle performance is recorded every time the animal goes to drink at a water trough and the information is relayed back to a computer database. Not only does this give the producer vital information in recording cattle performance, it also allows the identification of underperforming animals which may require medication or preferential treatment.

7. New Zealand

I arrived home from North America, weaned our calves onto grass, put the rams out with our ewes then caught a plane to New Zealand at the beginning of November. As I mentioned earlier, I had been to New Zealand in 2009, then again in 2010, and each time I returned home inspired by their attitudes and systems considering their unsubsidised production. I wanted to go back to learn more and, through the new world of a Nuffield Farming network opening up in front of me, this was made possible. I flew into Auckland and started off in Northland with some visits aided by fellow Nuffield Farming Scholar, Tafi Manjala.

I began by first having the privilege of meeting previous Nuffield Farming Scholar, Coopworth breeder and now also Beef and Lamb New Zealand Chairman, James Parsons. Beef and Lamb New Zealand is the industry levy funded body that provides extensive support, development and marketing for beef and lamb producers in New Zealand. We talked a lot about the main opportunities and challenges currently facing the beef and lamb industry in NZ as well as identifying some of the best ways of managing production at farm gate level. As I had often found in previous countries I had visited, the gulf between the top and bottom performing producers also exists in NZ. We can relate this back to land type and farm limitations but there is also a difference in management types; and part of BLNZ's remit is to begin to understand these behavioural differences and address them.

After meeting James on day one in NZ my mind was full of ways to go about making the changes that we needed to make to improve our beef and lamb production systems at home. It started with knowing that a disciplined approach to implementing a new strategy is critical and identifying all the key performance indicators in any such business is key. The top producers know their costs (fixed and variable) per kilogramme of dry matter of grass that they grow, and are acutely aware that increased business output does not necessarily mean an increase in profitability. This sounds very much like stating the obvious but I believe that many producers in the UK overlook this basic principle in chasing high prices at market! I spent a number of days in Northland meeting a variety of beef and sheep farmers as well as also staying with beef and dairy farmer and previous Nuffield Farming Scholar, Alec Jack. Many of the beef and sheep operations I visited in Northland were not carrying suckler cows as

> Farmax is a computer software programme that is used as a feed budgeting and management tool for making current and potential business decisions. It factors in physical data and incorporates that with financial so that profitability of different enterprises and scenarios becomes predictable.

the beef output arm of their business but instead ran grass-based dairy bull grower/finishing enterprises. This enabled them to improve grass quality for their sheep enterprise with cattle - that often constituted the smaller proportion of their business output but helped improve lamb production efficiency.

On my way down through the North Island I stopped in to meet Farmax consultant Steve Howarth at the Farmax headquarters in Hamilton. Farmax is a computer software programme that is used as a feed budgeting and management tool for making current and potential business decisions. It factors in physical data and incorporates that with financial so that profitability of different enterprises and scenarios becomes predictable. For example, if climatic conditions are favourable and grass supply is starting to creep too far ahead of demand, Farmax can instantly tell you how much you would have available to conserve or feed to trading stock without subsequently going into a feed deficit. As well as being a detailed feed budgeting tool, Farmax has the capability of informing the user what his/her cost of production is per kg of DM grown, which is a very useful figure to have in benchmarking a business from one period to the next.

One of the highlights of my trip to New Zealand was meeting up with Sam and Hannah Morrah who put up with me staying with them for three nights at their property, Ohineumeri Station, in Central Hawkes Bay. Sam and Hannah are part of a group of beef and lamb producers specially selected from all over New Zealand to take part in on farm research trials with the objective of contributing feedback towards industry development from producer through to consumer. Formed in 2010 this initiative is known as FarmIQ and is funded by state and private investment. To try to put FarmIQ into context, The New Zealand Institute of Economic Research estimates that it will grow NZ's GDP by $8.8 billion NZD by 2025.

I had the good fortune of passing by Central Hawkes Bay when the 8th FarmIQ meeting was taking place. This involved overview and update presentations from producers involved, as well as a farm tour and discussion at Ohineumeri Station. Sam and Hannah had just taken on a lease block in addition to their owned area but current numbers were approximately 3500 Highlander breeding ewes plus some trading cattle. They are intending to substantially push up numbers in the coming years, which will provide more scale to utilise labour, thus spreading their expertise.

In addition to nitrogen trials and collating pasture growth and quality data (including soil temperature/moisture monitoring) each producer within FarmIQ has variations of trials carried out on their farm, to keep research developments relevant to current industry challenges from region to region. In the Hawkes Bay area, the challenge is managing feed in generally dry summers and wet winters. In effect they have a "double dip" in pasture growth, which is buffered with forage crops during these periods. For summer supplementation, rape, chicory and plantain are grown whereas, in the winter, swedes, kale and oats are grown to fill the feed deficit. All stock on different feed regimes are monitored

for body condition score: from ewes at mating right through to the eating quality of the resultant progeny. This is all facilitated with the use of EID and software that is constantly being upgraded to improve the management efficiency.

Sam and Hannah Morrah's property, Central Hawkes Bay

Before leaving the North Island I managed to meet a number of other farmers as well as Scottish born and bred consultant, John Cannon, who manages Challenge Consultancy, based in Hastings. John uses Farmax with a lot of his customers and I had a very interesting discussion with him - being that he has a wealth of experience within both UK and NZ based beef and sheep operations. Interestingly, John has found there to be a strong correlation between simplicity and increased revenue, which was reassuring for me! We ventured across topics relating to more efficient production including contribution of rotational grazing to higher ewe efficiency (weaned lamb/mated ewe weight). John emphasised that of course the key is to strike the balance between science and management cost.

… John has found there to be a strong correlation between simplicity and increased revenue

After a whirlwind trip round the North Island I took the ferry from Wellington over the Cook Strait to Picton and made my way down the South Island. I met with Tom Fraser, a well-respected senior scientist at Ag Research's Lincoln base near Christchurch where we were able to analyse ways in which he had found producers improved profitability, particularly in

Coopworth ewe hoggets with lambs and dairy bull grazing in the background: Northland, NZ

lamb production. From a combination of scientific research and practical experience Tom Fraser has an enormous amount of information to give. We talked through a number of key performance indicators as well as the importance of achieving good post-grazing residuals without compromising animal performance.

An interesting comment that he made was that we now have the genetic capability to reach weight specifications in lambs by 100 days, so should be more focused on improving growth rates within this time frame rather than being concerned about post-weaning gains. Days-to-slaughter is a critical KPI in lamb production and if lambs can be finished earlier, surplus feed can be conserved or used to increase profitability with trading stock, whilst capital stock require maintenance-only immediately post weaning.

I went on to meet Tom MacFarlane near Ashburton to see and learn about his operation. In conversation about cell grazing and operating leader-follower principles in mixed grazing, Tom highlighted the importance of categorising stock by priority before implementing a grazing plan. This seemed like quite an obvious procedure to follow but the importance of getting the priorities right is fundamental to the end effect on animal production and ultimately profitability.

Beyond my time in Canterbury I headed farther down the South Island and spent time in the Southland region where they have a similar grass growth curve to some areas of the UK, particularly our West Coast. During this period I met 2013 ewe efficiency competition winners, The Welsh family at Twin Farm Genetics, as well as catching up with FarmIQ farmers, Barry and Julie Crawford at Gore.

At Twin Farm Genetics, they breed Tefrom and Suftex rams which are run on strictly commercial lines within their 5000 plus breeding ewe flock. Tefrom are a 3 way cross of Texel, East Friesian and Romney, while Suftex are three-quarter Suffolk and one-quarter Texel. Annually 2500 lambs from the recorded ewes are tagged and, as well as birth weight being assessed, attention is also given towards mothering ability and teat placement. At Twin Farm, during lambing, every lamb that dies before 3 days of age is autopsied to establish the cause of death. I myself would be inclined to blame the weather for most mortality at lambing but, interestingly, the cause of death was, more often than you would expect, determined as damage at birth.

As well as the Highlander bred commercial ewe operation at the Crawford family's Rosebank Farm near Gore, they also run a pure-bred Primera breeding flock for Focus Genetics. In 2011 and 2012, the Crawford family achieved an output of 340 and 373 kilogrammes of carcase weight per hectare from their 3500 + ewe flock. Now, in 2013, when set stocked to lamb at 15 ewes per hectare, within their FarmIQ ambitions they have set a goal of lifting this output to 450 kilos per hectare. Whilst aiming to achieve this target they are carrying out a variety of trials that are being quantified both in production terms along with their effect on profitability. Included in the trials are a pasture renewal programme, animal health plan with monitoring (including the benefits of a Faecal Egg Count Reduction Assessment), pasture monitoring (monthly grass measuring using a trailed grass growth reader with GPS!) and a parental gateway[2] system amongst a few others.

On my tour of New Zealand, whilst realising that EID tagging of sheep can be a lot of work, the benefits in terms of speeding up management for genetic gain are exciting.

On my tour of New Zealand, whilst realising that EID tagging of sheep can be a lot of work, the benefits in terms of speeding up management for genetic gain are exciting. The problem can be that linking ewes with lambs means having to tag lambs on an individual basis as close to birth as possible in order to match up correctly. This, at a time when labour is already stretched, can make it infeasible; so, with the parental gateway that Barry and Julie are trialling, lambs are batch tagged at tailing when labour is more available. The gateway is then set up in a field situation for ewes and lambs when accessing another paddock or water trough and the more times they pass through it the more accurate the resultant match making profile is.

I spent the last few days in Southland with John Scandrett, a beef and sheep consultant from Invercargill whom I had met in the UK a few months prior to my NZ visit. John allowed me to tag along on some visits to clients where I was able to learn first hand a lot behind their thinking and mind-set. In this situation I was able to witness different producers' thoughts when an experienced consultant challenged their decision-making. It was also a

[2] Parental gateway – EID reader which monitors sheep that pass through it and links ewes with progeny.

valuable insight into the physiology of grass and, as temperatures were starting to rise and grass was starting to try to go to seed, I was able to see how they were concentrating on maintaining sward quality whilst keeping intakes up in heavily lactating ewes with growing lambs.

GPS Grass measuring equipment by GrassCo on Rosebank Farm

8. Australia

Being in the southern hemisphere at a time when workload was relatively low at home, I thought it sensible to make best use of the long flight time and also experience some production systems in Australia. Most of my time was spent in the more temperate areas of Victoria and South Australia where I was able to see beef and sheep operations as well as visiting previous Nuffield Farming Scholar Michael and Victoria Hastings's ostrich farm. In normal circumstances much of these regions (particularly in south west Victoria and the south east of South Australia) experiences around and over 750mm of rainfall per annum although during my visit some were facing a sustained drier period than normal for the time of year.

Through Nuffield Farming associates Matt Ipsen and Lachie Sears, respectively in Victoria and South Australia, I was able to learn a lot about what producers are doing in these areas of Australia to improve profitability through optimal utilisation of pasture growth. As with every region and country I visited, the pasture growth curve varies and farmers obviously adapt their systems to best manage stock rates over the seasonal peaks and troughs. In the areas that I visited, particularly in western Victoria, pasture growth gets to over 20 kilos of DM per hectare per day in August, climbing to over 100 in October before taking a sharp decline in December. In fact, 65% of annual pasture growth occurs during the months of September, October and November, which represents quite a management challenge.

Te Mania bred Angus bull at Murdeduke Angus, Victoria Australia

I had the good fortune to meet with Peter Ham of Hamilton Produce, Hamilton in south west Victoria, who pointed me in the direction of some top producers, mainly with mixed suckler cow and breeding ewe enterprises. Of these, one such visit was to the well renowned Yarram Park, known for their pedigree Hereford (700 pedigree and 800

commercial) cattle and large composite prime lamb production from their flock of over 10000 ewes. Jeremy Upton, Manager at Yarram Park, manages production within their ewe flock to help profitability by aiming to have 25% of lambs sold off ewes before weaning - which varies depending on the year. In the past 7 years they have experienced below average rainfall but are still managing to sell 65% of lambs on a deadweight basis whilst the remainder are sold store before the end of November when the summer dry period kicks in and slows up pasture growth. One of the keys to this system is a lighter mature ewe weight and, by minimising energy requirements of capital stock, they can achieve an optimal carrying capacity over the dry period and ewe body condition is more easily maintained.

After visiting Yarram Park I was able to go on and visit Ardgartan Pastoral Company, near Grassdale in Victoria. At Ardgartan, owned by Harry Youngman, they run 1200 Aberdeen Angus cows plus followers alongside 17500 composite ewes, which were being shorn by 7 shearers when I was there. With each shearer doing over 300 a day there was a lot of activity between drafting lambs off prior to ewe shearing plus all the wool handling. Cattle Manager at Ardgartan, Brett Kissel, took the time to show me round the company's mixed livestock "techno grazing" block that is operated on 540 hectares of the 3200 hectare property. This 540 hectares has been developed to incorporate "techno grazing" using an NZ originated system called "Kiwitech" which has already nearly doubled the area's carrying capacity and consequently the net margin per hectare. Since being established in 1987, Kiwitech has overcome the problems of labour intensive grazing systems and expensive field subdivision and water reticulation issues with a range of fencing and watering equipment to ease the operations. By adopting the Kiwitech system, Ardgartan Pastoral Company is achieving this productivity and profit with lower artificial fertiliser used per kg of live-weight gain, which also represents a huge environmental benefit.

Farm motorbikes set up for techno grazing on kiwitech system in South Australia

9. Brazil

After pregnancy scanning the ewes at home in January, I squeezed in a trip to South America with a view to learning more on the scale and potential of the large beef producing nations of Brazil, Uruguay and Paraguay. I flew into Sao Paulo, Brazil, which - with a population of 20 million people - is the largest city in the southern hemisphere. From there I headed out to Piracicaba where I met with Miguel Cavalcanti of Beefpoint, a firm established in 2000 to provide knowledge, information and industry development. Miguel was able to give me an insight to Brazil in general and their beef industry; 40 million prime cattle are slaughtered annually in Brazil, which, when compared to just over 400 thousand per annum in Scotland at present, gives some perspective on the scale they have. I was somewhat surprised to learn that, of the 40 million cattle processed, only 3-4 million are feedlot-finished whereas the rest are predominately grass-finished with some producers using a combination of both systems. In the more temperate, southerly regions of Brazil, native bred cattle, primarily Angus and Hereford, are predominant whereas as you travel north into the more tropical climes, the main beef breed used is Nellore, which as I understand, is that of *Bos Indicus*, of Indian descent. This breed of cattle copes well with the heat as well as being able to withstand parasitic challenge although the meat is deemed to be of a lesser quality when compared to Hereford or Angus.

As the UK beef industry has experienced, competition from other land use is becoming more of an issue in Brazil, particularly from the cropping industries as they experience higher returns through global demands for commodities such as soybean, corn and sugarcane. Currently 25% of Brazil's land area is in grassland, 10% in cropping, 10% in urban development and the remaining 55% is in forest and native vegetation. Deforestation has been a major issue and continues to happen, often illegally, but the current and previous government has made significant efforts towards 'neutral deforestation', ie compensating any reduction in forests by new plantings. However, Miguel and Beefpoint have recognised the opportunity potential that lies within improving production efficiency from the current grassland area alone - through factors like improved fertility, weaning rates and growth rates. As well as aiming to improve the marketing of Brazilian beef, there are benefits in integrating cropping with beef production to bring about increased yields in crops after grass and vice versa.

My next meeting was with Professor Sergio De Zen, a senior economist at the University of Sao Paulo in the Centre for Advanced Studies and Applied Economics (CEPEA). The main function of this Economics Research Centre based at the agricultural university's campus in Piracicaba, is to contribute towards creating more efficient and sustainable management of agribusiness by providing a lot of detailed analysis for the agricultural industry. As a result, daily information is collated and analysed at the centre to provide price-indexing, estimates and risk evaluations for all involved. Professor De Zen had reiterated what Miguel had said regarding land use in Brazil in that at the moment the industry does not necessarily need

more land but rather needs to be more efficient at utilising the land currently available. Brazil currently has a beef cow herd of approximately 80 million head which is more than double that of the United States of America, although Brazil produces more than 20% less beef than the U.S.A. Clearly, with its kind climate and proximity to large volumes of feed grade grains and by-products from the processing sectors, and with improved production efficiency, the beef production potential in Brazil is massive.

After visiting a few farms in Sao Paulo State and learning more about the University of Sao Paulo's research facilities, I caught a flight up to the country's capital, Brasilia, where I met with Greg Lindsay of Leitissimo. From there we travelled 5 hours north east - the last hour of which was on dirt tracks - to reach Leitissimo's base in Bahia State. At Leitissimo they directly supply retailers with UHT milk all produced and processed on site. Starting with bare ground in 2004 they now run 2500 cows plus followers on 8 blocks each of 56 hectares. Milking cows are stocked at 10 per hectare!

I don't think I have ever come across such a passionate and driven group of people with the ability to overcome any issue thrown their way. Director Simon Wallace, after travelling extensively around Brazil in a beat up Volkswagen Golf, arrived at his choice of location in Bahia State for several reasons. The temperature range is 15^{o}C to 30^{o}C throughout the course of the year from winter through summer, so grass grows all year and relatively evenly. With a rainfall of over 1400mm through the warm season, precipitation is plentiful in the form of rain, and provides groundwater for irrigation during the drier season (aiding the evenness of growth). So good are their growing conditions that they can achieve annual grass production of over 40 tonnes of dry matter per hectare per year. To put this into perspective, in good grass growing areas in the western areas of the UK we can achieve up to 16 tonnes on well managed dairy farms. I must add that this grass is different to the temperate perennial grasses we use in the UK and is known as Brachiaria or Tifton 85, tropical grass which achieves approximately 83% of the value in milk output as PRG. In addition to this they are 500 kilometres further north than the next major milk processor in a state with a 750 million litre per year milk production deficit.

When they arrived at the location:

- They needed access; to date they have installed approx. 40 kilometres of track.
- They did not have power; they installed 22 kilometres of overhead power lines.
- They were having to transport milk over 500 kilometres to an outlet; they built their own processing plant with a UHT (ultra high temperature) processing facility to better withstand the longer delivery times.
- Employees' children were having to travel 50 kilometres to school; they built their own school and employed a teacher.

The list goes on including the training and education of the now 85 employees within the business. It would be fair to say that Leitissimo is there to stay.

10. Uruguay

I arrived in Montevideo, the Uruguayan capital, late on the night of February 23rd and was greeted in the hotel foyer early the next morning by INAC staff, Jorge Acosta and Felipe D'Albora. INAC stands for Institute Nacional de Carnes or National Meat Institute and was formed to provide traceability and certification for meat products originating from Uruguay and destined for higher end markets such as that of the EU. It is interesting to note that no growth hormones have been used in Uruguay since 1962 and there has been no FMD since 2004.

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Uruguay has a population of nearly 3.4 million people and it is expected that 4.2 million beef cows will be mated this year with 12 million head in total in the beef cattle sector. With a current average weaning rate of 63%, 2 million cattle are processed each year of which 30% are consumed domestically and the remaining 70% exported. Uruguayans have overtaken Argentina recently in beef consumption with almost 58 kilogrammes consumed per capita.

Herefords in Uruguay

In Uruguay, the west side of the country is generally more fertile and used for cropping, whereas the east runs mainly beef cattle with areas in rice production. Their sheep numbers have substantially reduced so now grassland areas are mainly used for beef cattle, where

Aberdeen Angus and Hereford prevail. Of these areas, 84% is formed of natural, native pastures and the other 16% is classed as improved grassland.

Jorge, Felipe and I travelled 5 hours north east from Montevideo, to visit the Estancia Ana Paula, a 6400 hectare beef ranch located beside the Uruguayan border with Brazil. Here we met with Dr. Emilio Reyes, Fernando Severo and Fabio Almeida. Estancia Ana Paula is home to 4000 Aberdeen Angus and Hereford breeding cows plus followers, all based on UK genetics. Above national average weaning rates of close to 80% are achieved and North American genetics were tried but did not perform as well in their intensive grass based system. They have now subdivided nearly 1000 hectares into 2 hectare blocks which has pushed the production output from 120 kg of live-weight gain per hectare to over 450 kg/hectare. Lotus, a leguminous plant, has helped considerably in nitrogen fixation to obtain this production increase, which is a significant output lift and is reflected in more profit. It is intended to continue subdividing to further improve production.

The following day I visited an INAC-certified processing plant owned by PUL, near Melo in North Eastern Uruguay. 550 staff are employed and 500 beef animals per day are currently being processed here. The plant has the capacity to process over 1000 head per day with the same staffing but beef supplies in Uruguay are quite constrained at present. The average carcass weight of animals processed is 240kg, which is over 100 kgs lighter than the UK average and the difference in live-weight is close to 200 kilogrammes. As the carcasses are processed weights are taken at 7 key stages giving a very accurate reflection of variance between animals; farmers are paid after point 4, post dressing. Current values that producers were receiving for beef in the week I visited were 3.38 USD/kg and. as this plant was certified for global export, most of the beef being packaged was destined for overseas markets.

As the carcasses are processed weights are taken at 7 key stages giving a very accurate reflection of variance between animals; farmers are paid after point 4, post dressing.

After visiting this processing plant, we carried on to La Soledad-Revello farm where, in addition to my actual visit, Jorge, Felipe and an INAC vet carried out an annual audit inspection at the farm. This resembled something very close to a farm assurance compliance inspection that I have experienced at home through QMS (Quality Meat Scotland) although we would not have had a qualified vet present. At la Soledad-Revello last year they weaned 73% from their herd of 665 Aberdeen Angus, Hereford and Shorthorn bred suckler cows that are run on 2000 hectares of mainly native pasture. Through the use of artificial insemination they are planning on improving herd performance going forward.

My next stop was to INIA, the National Agricultural Research Institute, which is based at Treinta Y Tres and one of five such centres across Uruguay. INIA is co-funded between an

industry levy of 0.4% that is matched by government support. On arrival at INIA, I was greeted by Joaquin Echeverria along with Pablo Rovira, Walter Ayala and Graciel Quintans. Together they gave me a detailed insight into the Uruguayan agricultural industry and particularly the beef sector. Afterwards, Joaquin facilitated two days of seeing their main areas of research including beef breeding trials, grass finishing steers and endophyte fescue trials along with some visits to local producers.

As I stated earlier Uruguay currently produces 550000 tonnes of beef of which 70% is exported. Objectives include pushing production up to 750000 tonnes per year (for which they currently have processing capacity) with a view to exporting all the additional meat. One of the ways they hope to achieve this is through lifting their fertility and average calf-weaning rate from 63% to 75% from cows mated, whilst focusing on improved grassland management for optimal livestock performance.

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On my last day in Uruguay, I visited the INAC headquarters in Montevideo. Near to there, in the central business district area, INAC has a visitor centre where the public can go to learn about the provenance, traceability and quality assurance when eating Uruguayan produced beef. This is an interesting concept and one which instils the pride which every Uruguayan feels towards their beef industry.

Angus cattle cell grazing in Uruguay

11. Paraguay

The last country I visited through my Nuffield Farming Scholarship was to be Paraguay, another South American country with huge production potential given market access. I flew into the capital, Asuncion, where more than a third of the 6.5 million population lives within the metropolitan area of the city. Another 1 million people live within an hour's drive of the city so the rest of the country is quite sparsely populated given that it is nearly twice the physical size of the UK.

Since it has begun to overcome a long period of political instability, Paraguay has experienced beef cattle growth like no other country in Latin America. Since 2011 the herd has grown by nearly half a million head and in the next five years it is expected to continue to grow at the same rate. At present beef cattle numbers stand at over 12 million head, which ranges from subsistence farming to herds of thousands. I had the privilege of being shown some of the country by Massimo Coda, an Italian-born, Brazilian-educated, agronomist, turned large-scale beef farmer.

As we drove out of Asuncion on my first morning in the country I had never seen anything like the queue of lorries laden with soybean and waiting to be unloaded. These drivers often queue for 3 days at a time. …

All of a sudden I became intensely appreciative of the infrastructure and ease of access to market that we take for granted every day in the UK.

I had often heard of the problems some South American countries are up against concerning infrastructure and the transport of goods to market. But, as we drove out of Asuncion on my first morning in the country, I had never seen anything like the queue of lorries laden with soybean and waiting to be unloaded. These drivers often queue for 3 days at a time. Paraguay is landlocked and a lot of goods for export have first to be loaded onto barges and taken down the Paraguay River to either Buenos Aires or Montevideo to be exported. The Atlantic Ocean can be reached through Brazil by road but this is really only viable from the eastern side of the country. All of a sudden I became intensely appreciative of the infrastructure and ease of access to market that we take for granted every day in the UK.

We headed North from Asuncion and I spent the next few days looking over Massimo's properties, learning about his production methods and meeting with his staff. Massimo has two breeding properties and two grower and finishing farms totalling over 40000 hectares and as far apart as 1000 kilometres. Much of the areas that he owns remain forested and as the regions are tropical, cattle breed is comprised primarily of Nellore cattle with some use

of Aberdeen Angus bulls as a terminal sire. Improved grassland areas are developed with Brachiaria and Panacum grass varieties.

Nelore cattle on Massimo Coda's finishing farm, Paraguay

Similar to what I had experienced in Brazil, and due to the remoteness, most of Massimo's employees are accommodated on the ranches in houses of a far better quality to what I saw in many of the small townships. Throughout the areas we passed through I would describe the living conditions as poor. In fact, in a country where poverty and subsistence farming exists throughout, the employment that Massimo has created with his business model has opened up an opportunity for people to really progress themselves. They have an opportunity to learn about ambitions beyond merely feeding themselves and their families every day.

He has had staff who were illiterate when they began employment with him but now have children who have gone on to study medicine and accountancy.

Not only does Massimo offer employment for people but also an education for them and their children. He has had staff who were illiterate when they began employment with him but now have children who have gone on to study medicine and accountancy. In addition to this, as a production incentive to his ranch managers, foremen and cowboys, ownership of cattle is arranged so that employees have a vested interest in performance. This encourages better stock management during periods of high rainfall, and also - and particularly - in drier spells

when it is necessary to climb into orange trees and shake them out to supplement feed for cattle on the ground below!

Herding Nelore calves in Paraguay

I went to South America to learn about improving efficiencies of forage-based production. I left feeling that in countries such as Paraguay, with its huge production potential, not only can they contribute towards feeding an increasing world population demand but can, just as importantly, go on to better their own lives in doing so.

I went to South America to learn about improving efficiencies of forage-based production. I left feeling that in countries such as Paraguay, with its huge production potential, not only can they contribute towards feeding an increasing world population demand but can, just as importantly, go on to better their own lives in doing so.

12. Discussion and recommendations

After having travelled around several countries of the world it became increasingly apparent to me that back in the UK our systems mostly have very high fixed cost structures. I think that our over-capitalised and often complicated systems are too dependent on volatile inputs, which makes it increasingly hard to keep a positive figure on the bottom line.

For me, whilst I do not think we ourselves could necessarily replicate a true New Zealand type system, I think that we could apply more of their basic principles. My area, like many others in the UK, can grow good quantities of grass for 8 months of the year and I believe that a more focused management of this attribute could realise great potential for business improvement. Grazed grass is by far the cheapest feed we have available, especially in the area where I live (Newton Stewart, Wigtownshire). In order to clarify my thoughts and findings, I have broken my study topic down into three main parts:

- grassland management
- beef
- and sheep

These will be discussed in the following chapters.

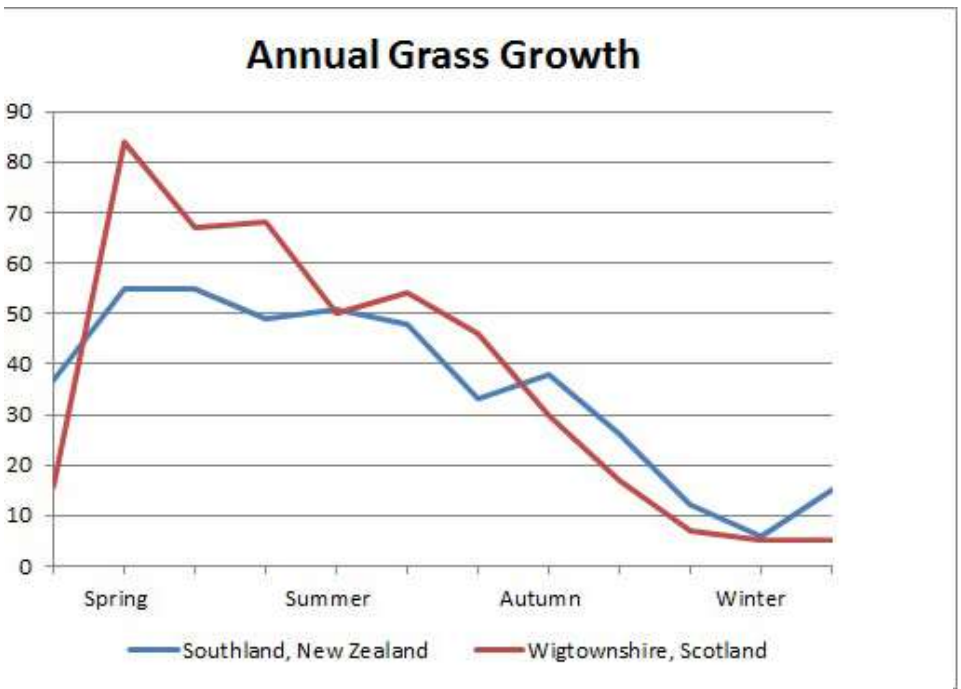
Three wire fence for finishing lambs on forage rape

13. Grassland management

The most common form of grassland management on lowland beef and sheep farms in th UK is that of set stocking, with similar stocking rates on the ground over the growing season from one year to the next. Generally, cattle are housed at the onset of winter and sheep stocking rates are also reduced outside during winter as grass growth slows up. Some ewes may be housed and some may stay out but generally the grass supply deficit will be made up with some form of supplementary feeding until spring, when they lamb and grass growth kicks off again. Cattle turn-out date is dictated by when ground conditions allow and when grass is available. In many cases fertiliser applications tend to be based on what has traditionally been applied - as opposed to what is specifically required by the soil for optimal pasture utilisation and production.

Unfortunately, set-stocked grassland management does not encourage anything like the production potential that grass has to offer; rather it allows livestock to continually select preferential species, which gives less desirable “weed grasses” an earlier opportunity to increase their pasture presence. Another drawback to this method of grazing is that, as the preferential grasses try to form new tillers or shoots, they are repeatedly grazed off and this has a detrimental effect on the plant’s root reserves, which slows subsequent regrowth.

In swards that are continually grazed tight to the ground, clover is often preferentially selected out by the livestock to its highly palatable composition. Stolons are restricted from spreading and clover presence diminishes. This has a costly effect due to the nitrogen fixating benefits this plant brings to the ley. With a clover content of 30%, 150 kilogrammes/ hectare per year can be fixed.



A NZ grass growth curve (Dairy NZ) with a growth curve from a dairy farm in Wigtownshire

The above graph compares a Southland, New Zealand grass growth curve (Dairy NZ) with a growth curve from a dairy farm near to me in Wigtownshire. This details the growth spike we have in spring and our declining autumn growth. As grass growth declines, demand has to be reduced by, for example, offloading lambs or weaning calves to reduce cow requirements.

Controlled or rotational grazing is nothing new but it is widely ignored by our beef and sheep sectors. It allows grassland a period of recovery whereby the faster growing, higher quality perennial rye grass varieties maintain their sward presence by out-competing the slower growing weed grasses. Also, plant regrowth follows somewhat of a sigmoid curve (as it grows more leaves it can photosynthesise more) and so the less time that stock are on an area the better for allowing optimal speed of regrowth of that area before the next round of grazing. Best grazing quality of perennial rye grass is achieved by grazing when the plant is in its vegetative stage, ideally between the emergence of its second and third leaf. In achieving this livestock are presented with a high quality sward where every bite is of optimal quality and the required animal feed demand is met with minimal energy expended. Grazing at or before the emergence of leaf stage two impedes the re-growth potential and, after the fourth leaf has emerged, the first dies off; so grazing before this occurs helps to avoid the build-up of dead matter in the plant base. Also, once the fourth leaf emerges and the first leaf senesces, plant growth rate slows down drastically as it loses surface area to photosynthesise – i.e. as the plant reaches the end of the sigmoid curve.

As I was told on a visit in Ireland, pre-grazing height determines post grazing residual, meaning that the closer to optimum leaf stage or height that the grass is grazed, the more of the plant that is of higher quality and therefore grazed off and utilised. Plant efficiency is therefore better as the time it spends growing is maximised as it starts the cycle again. Post grazing height is ideally in the 1200 -1500 kg/hectare bracket which is about 3-5 centimetres in height, depending on the time of year. In spring when growth rates are at their highest the grazing round (time elapsed from one grazing to the next) can be as fast as every 18 days whereas in the autumn, as grass growth slows down, it can be more than three times as long from one grazing to the next.

pre-grazing height determines post grazing residual

For maximum grass utilisation it is necessary to match grass supply with demand, which suits a spring lambing and calving system where peak demand at close to mid lactation is matched with peak grass production. Demand depends on things like stock category and stage of lactation. Dry matter intake is calculated as being approximately 3% of the animal's bodyweight. In breeding ewes, the figure used is 4% for late pregnancy and less than 3 % for post weaning. So for example a 75 kilogram ewe would require 2.25 kilogrammes of dry matter per day post weaning. In basic terms, if we had 500 ewes and wanted to feed them for one day we would need to provide them with 1125 kilos of dry matter. So we would aim to provide them with 1 hectare and enter it when approximately 2600 kilos of dry matter was available, and leave a residual of approximately 1500 kilos.

In order to know what the supply is we obviously need to measure grass growth, which is done in kilogrammes of DM per hectare per day. This can be carried out with a sward stick or rising plate meter or, like in the photograph earlier, with a fancy trailed reader! *(See photo on page 22*). A weekly reading gives a good indication of grass availability and sward performance (to identify good performing fields versus poorer ones). This information can then be analysed to help decide where to graze next and, depending on livestock demand, how large an area to give them. There are now good computer software programmes such as FARMAX that, once details of stock numbers and classes are entered, can accurately predict the grass growth required to meet demand. This can detail when there may be a feed surplus or indeed when there may be a feed deficit. A feed surplus will be required in order to conserve forage for the winter period. In the case of a graph showing a deficit, measures can be taken to negate this by, for example, reducing stock or planting a brassica crop for that period. Grazing can also be taken from the surplus period and "deferred" to be used later in the year when grass demand surpasses supply.

A useful tool for informing where to graze next is a 'feed wedge graph'[3]. Simply put, this provides a visual picture of the current pasture situation by ranking the field's average pasture cover. Surpluses and deficits can be identified and decisions can be made depending on the time of year. *For further details concerning grass wedge and paddock setup, see Appendix on page 49.*

Mixed livestock grazing systems help towards increasing kilogrammes of meat output per hectare. This is complemented through breaking parasite challenges and also due to the different selective natures of cattle versus sheep. As I learned on my travels, leader-follower principles are often followed in these systems whereby different stock classes are prioritised depending on their requirements and importance. This enables the person in control to maximise production by directing highest quality swards to where it is most needed for the highest return.

It would be wrong to discuss grassland management without talking about soil, after-all, "mankind was built on 3 inches of it"! Well, certainly in my area anyway! Taking a soil analysis is a very cost effective way of identifying where best to apply lime and fertiliser in order to get best return for the money invested and also for the environmental cost that comes from applying fertilisers to soils that cannot utilise it. The table below best illustrates the benefits of applying fertiliser to soils with the correct pH. Liming to increase pH not only improves the uptake of key nutrients like nitrogen, phosphate and potassium but it also helps promote biological activity in the soil and improves soil structure.

See chart on next page.

[3] A grass feed wedge is a graph of pasture covers (y-axis kg/dm/ha) and field descriptors (x-axis) for a farm on a selected day detailing each field from longest to shortest cover. Ideally the line drawn along the graph should resemble a wedge shape showing surplus and deficits and thus providing the operator with information for key decisions. A feed wedge is ideally generated on a weekly basis and in simple terms the longest cover will be grazed first.

	N	P	K
pH 5.0 (very strong acidic)	53%	34%	52%
pH 5.5 (strong acidic)	77%	48%	77%
pH 6.0 (medium acidic)	89%	52%	100%

Effect of pH on key nutrient uptake (*CAFRE: Beef – Improvements in Technical Efficiencies*)

AA x Hereford calves out wintering on forage rape

14. Beef

In my opinion beef breeding in the UK has been almost too focused on production figures and achieving figures like high 400-day EBVs. Achieving high EBVs has encouraged intensive feeding and beef output but at the cost of vital maternal traits for profitability - such as fertility and cow size.

I mentioned earlier in this report the importance of key performance indicators (KPIs) which are relatively unknown within both beef and sheep systems. It has been said before and it will be said again, if we don't measure something, we can't manage it and of course the critical factor is in knowing how to collate the information gathered to improve our profitability.

An important figure for a lot of the top beef producers I met was that for cow efficiency. This is taken from the weaned weight of the calf at approximately 200 days divided by the live-weight of the cow. A rule of thumb is to try to achieve between 50 and 60%. Some places I visited were achieving 65% with no creep feed! By factoring in the live-weight of the cow - and therefore the kilos of animal that the producer has to pay to maintain - and dividing this by what she is giving on an annual basis in output, allows for this accurate measure of performance. The identification of top performing animals and bottom performing animals allows for improvements to be made on actual performance and not just by feel.

Cow weight is a factor that I think needs to be reduced, both to graze grass in the shoulders of the season and also to lower the cost of keeping the cow for the year. If we can add two months on to the grazing season that means 60 days less to house, and less requirement for expensive machinery.

An effective way of helping to reduce mature size and increasing output from the cow over her lifetime is by calving her at two years of age. Given the right genetics, this makes for a compact cow that is easier to keep and that calves progeny with the genetic potential to grow on to good weights. If bulling the heifers at 15 months, pregnancy scanning can be carried out soon after mating to ensure no passengers are carried, plus the barren heifer can still realise a good value. In any suckler cow system, if the cow or heifer does not get in calf she should be culled.

I think suckler herds need to be more specialised in the future, and focus more on calving cows, and taking progeny on to a store age to supply producers who have more specialised finishing structures

I believe that improving maternal traits in line with production traits will contribute towards an increase in output per hectare for the suckler cow producer. I think suckler herds need to

be more specialised in the future and focus more on calving cows, and taking progeny on to a store age to supply producers who have more specialised finishing structures, whether that be on grass or a cost effective alternative.

2 year old fresh calved heifers

As breeding for net feed efficient animals progresses an opportunity arises to use genetics capable of converting more meat from less feed intake. This opportunity represents a huge potential advance, which will bring economic benefits for producers whilst drastically reducing our beef industry's greenhouse gas emissions.

15. Sheep

I think that compulsory tagging of sheep in the UK is a great thing. We have not started to link parents with progeny here yet but a faster genetic gain in sheep relies on being able to do so. EID can really help us go forward especially when working with large numbers.

Ewe efficiency is a critical measurement that needs to be made in order to improve output per hectare and achieve optimum profitability from the ewe live weight maintained. It is possible to achieve 1kg of live-weight output per kg of ewe live-weight maintained. With the rainfall in my area close to 1400mm I would like mature weight of ewes to be brought down to 70 kg in order to achieve optimal grass utilisation in the depths of winter without making much mess. On well established farms that I visited this efficiency (1 kg of live-weight output per kg of ewe live-weight maintained) was being achieved at 100 days but it means optimum lamb performance and growth rates of 350 grams per day. I must admit to not having met this target yet but average growth rates to weaning last year were 330 grams (accounting for a 4 kg birth-weight) and with a good tailing this year we will not be far away.

We have not started to link parents with progeny here yet, but a faster genetic gain in sheep relies on being able to do so. EID can really help us go forward especially when working with large numbers.

I have had many discussions with people on what the optimum pregnancy scanning result should be. In my opinion, in order to keep days-to-slaughter down in a grass finishing system and reduce mortality at lambing, the target for me must be around 180% scanning and, assuming a 10% mortality, 170% at tailing (live lambs born). A rule of thumb that I repeatedly learned from top lamb producers in Australia and New Zealand was to only have 10 % of the lamb crop left by mating. This figure may vary depending on the ewe fertility and necessity for areas to be closed off for flushing, with higher ovulation as a result. With a tailing of 170% it would be acceptable to suggest that most lambs could be sold by mating time. Days-to-slaughter should be kept to a minimum and if a grass surplus presents itself then another stock category should be employed to utilise.

A rule of thumb that I repeatedly learned from top lamb producers in Australia and New Zealand was to only have 10 % of the lamb crop left by mating.

As I mentioned in my overview of the UK, a problem that I had been facing in wintering our own breeding ewes was in giving them what they wanted and not what they needed. So by the time mid-January came around I used to be right out of grass and had to resort to feeding concentrates. Since we now have an accurate record of our ewe weights for correct

dry matter allocation last year, we were able to all-grass winter half our ewes; this winter, facilitated by further subdivision, it is my intention to winter everything on grass without concentrate supplement. In New Zealand and the UK, trials have been carried out on grass allocation in winter through the use of 4-day shifts of the equipment, which has reduced the labour requirements with less electric fence and water trough shifting.

The general sequence of events over the calendar year is that of the ewes going on to a grass rotation immediately prior to, or just after, mating. When mating occurs with this rotation in effect, it is found that higher ram-to-ewe ratios can be used as the rams do not have to cover as much ground to find the ewes. Rams will come off but ewes will continue on the rotation until just prior to lambing when they are set-stocked (multiples on higher covers, singles on lower covers) and left that way until tailing when they start back into a rotation again.

After weaning, ewes are tightened up again and make way for the lambs who get preferential grazing to encourage as high growth rates as possible. Body condition score is monitored throughout to determine at what stage in the leader-follower system the ewes come in.

Romney ewe with twins back at home

16. Conclusions

- In the UK grass is the most economic feed available to ruminants and is massively under-utilised.
- UK beef and sheep sectors I feel are largely over capitalised and fixed cost structures need to be reduced
- In an expanding world population we cannot continue to feed grain to low feed-conversion efficient animals unless there are compelling reasons for doing so.
- There is an opportunity to improve beef cattle and sheep efficiencies (weaned weight/maternal weight)
- With improved grass management and subsequently improved animal performance there lies an opportunity to rear and potentially finish more animals in the UK from the beef, sheep and dairy sectors, at grass, in a less capital-intensive way.
- Differing areas should become more production-specific to the advantages and disadvantages they face

17. After my study tour

Before starting my Nuffield Farming Scholarship I had begun to implement some changes within our system and over the course of the last 18 months-2 years we have seen quite a lot of changes and improvements. The biggest change has probably been that of subdivision of fields and improving our electric fencing along with our water reticulation network.

We have been calving heifers at two years of age for over ten years now. All cattle are mated for 9 weeks and anything pregnancy scanned empty at weaning is culled. We treat our ewes the same and are now seeing the benefits of this in improved fertility/barren rates.

For the past two winters we have completely out-wintered our calves on rape and kale, which has brought about a number of marked benefits. An electric fence is moved daily with only a motorbike started up to get to the field. In the past these calves were wintered in straw courts and fed a total mixed ration but these costs are now gone. Calf growth rates are not as high through this period but the compensatory growth at turnout makes up for this. We now weigh our cattle young-stock every month from weaning until turning onto grass in spring and that has given peace of mind that we are heading in the right direction! In addition to measuring cow efficiency with our cattle we are now using body condition and deferred grazing (ground closed off in September) to keep cows out until mid-December without supplementation. This has helped in reducing our in-wintering period down to about 110 days before cows start calving and go back to grass once more.

With our sheep, I opted to change to a Romney genetic base because I could see the benefits in improved health and biosecurity with being able to breed our own replacements. I was also not enjoying competing with other farmers who had Single Farm Payments and were able to afford to pay a premium when buying replacements, and saw breeding our own replacements as a way of avoiding this.

The Romneys have adapted well to our more intensive grass-land management style and seem to enjoy grazing side by side whilst respecting the electric fences. They are a little bit lighter than the mules and seem to cope well with the system. For the first time this winter it is my intention to winter them as far as possible on grass by building a grass wedge going into autumn and “cell grazing” them before set stocking again before lambing. Hopefully, by lambing time next year we will have a better means of utilising EID to allow it to aid in breeding decisions going forward.

Beyond this, I would like to continue to push things forward as fast as possible including looking at incorporating dairying within our system. Regardless, I want to apply as much as I have learned through my Nuffield Farming Scholarship as possible. If you are ever passing, please drop by and give me your thoughts.

Niall Armstrong

18. Executive summary

UK beef cattle and sheep producers are and have been producing high quality beef and lamb for domestic consumption and export very successfully within the last century. UK genetics are recognised worldwide where they have evolved, adapted and performed exceptionally under an extreme spectrum of conditions with varying management styles.

However, while prices for the finished carcass remain relatively high, our costs of production continue to increase and these need to be controlled. With tighter margins, beef and sheep numbers on UK farms are declining and this can be addressed with more efficient production. For me, farming without Single Farm Payment along with what I have learned through my Nuffield Farming study tour leads me to believe this.

I travelled within the UK and also visited Northern Ireland and Ireland, the USA, New Zealand, Australia, Brazil, Uruguay and Paraguay. I came away from all of them with essentially the same key messages.

The major answer for me in reducing production costs lies in improving grassland management. Being able to graze livestock for the greater part of the year is key to profitability. Management achieves this – and as it is impossible to manage what has not been measured, grass growth on farm must be measured (in kg of DM per hectare per day). Grass supply and livestock demand are key elements in ensuring optimal utilisation of grass grown during the grazing season whilst creating a feed surplus is essential in order to conserve forage for winter grazing and supplementation through the seasonal trough of growth.

Obviously it is in the winter months that achieving sufficient grazing for livestock is most difficult. Feed demand on a lowering grass availability has to be reduced in the shoulder of the season which can be achieved by selling lambs earlier (genetics along with providing better quality pasture have made it possible to much improve lambs' live-weight gains during their first 100 days); keeping lower-weight breeding cows; and using forage crops or deferred grazing to buffer feed some stock early if grassland recording has identified a feed deficit later on.

Regardless, a disciplined approach to implementing a new strategy is critical and so is identifying your Key Performance Indicators. There is a strong correlation between simplicity and increased revenue.

Another key contributor to improved efficiency is the knowledge being generated from benchmarking and on farm trials. Seen particularly in Ireland and New Zealand the main aim of this is contributing feedback towards industry development from producer through to consumer. New technologies such as EID play an integral part in this as we look forward to being able to more easily collect, collate and interpret data.

Back in Wigtownshire, and post obtaining my Farming Scholarship I am continuing to subdivide fields whilst improving both the water reticulation network and electric fencing capabilities. To optimise the cost of these improvements I continue to strive to improve our grass based animal genetics within our closed herd and flock situation.

Finally, after realising how much grass we can grow, my business partner and I are currently looking into the possibility of incorporating dairying within our system.

Make the grass greener on your side of the fence!

See next page for Acknowledgments and Thanks

19. Acknowledgement and Thanks

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see next page for Appendices

20. Appendix

1. Starting out – assessing grass

• Don't have a fixed turn out date in your head – walk the farm and assess how much grass you have – most producers will have more than they think

• Always try and get livestock out earlier than previous years

• Increasing grazed grass in the diet should be viewed in the same way as setting up a winter ration – analyse grass fortnightly so you can accurately determine how much supplementation is needed throughout the season

• Whenever cows start to go out, start them off on 5kg DM a cow a day from grazed grass so there is no rapid change in diet – this should take her 3-4hrs to graze

• Aim to get cows out in February or at least two weeks earlier than usual – this will help set the grazing wedge up earlier

• Early grazing is probably best for in-calf, mid-late lactation cows

2. Paddock set-up

• The key is to allocate cows what you want them to graze, rather than giving them a choice

• Aim to have 20-30 grazing areas – you may only have five fields, but these can be split up into areas

• You don't have to spend a fortune on set-up if you're just starting out with a rotation – you can still get more from grass

• When thinking seriously about a rotation – think about investing more in tracks and water troughs

3. Grass wedge

• Ideally you want all your fields at different stages of grass growth

• Grass should be grazed at the 2.5 to 3-leaf stage for maximum efficiency

• Stock should start grazing a field when grass cover is at 2700-2800kg DM/ha

• Grass should be grazed down to 1500kg DM/ha

• Overall, average farm cover should be about 2200kg DM/ha

• Each grazing rotation (around all fields) is likely to be an average 25-30 days

• At peak growth, the round may take 15-18 days, with the round extending to 30 days when growth slows

Tools to achieve a grass wedge

• Using a rising grass plate meter to assess farm grass cover allows a grazing wedge to be accurately set up

• The plate meter provides kg DM/ha figures for individual fields – these can then be inputted into computer software to produce a grazing wedge which can be used to determine which fields should be grazed or taken out for silage

• Walking the farm weekly and collating figures provides early warning as to whether you are likely to see a grass surplus or shortage in 10 days' time

Relying on grass height alone can give an inaccurate picture of grass cover.
Counting the leaves will give a better idea of whether a field is ready to be grazed – when a field has been grazed consistently all over, you will only need to count 2-3 plants to get an idea of cover.

However, a plate meter is by far the best means of setting up a grass wedge. "The plate meter is equivalent to the weigh scales on the mixer wagon, providing you with actual figures you can use to calculate feed requirements."

4. Supply and demand calculation

Assessing supply and demand is essential in managing the grass wedge:

Demand = Number of stock x required kg DM per animal a day from grass

for example, 150 cows x 15kg DM a cow a day = 2250kg DM demand

Supply = Total hectares of grass available x grass growth rate (Growth rate can be easily calculated when comparing covers from week to week using a plate meter)

for example, 45ha x 45kg DM growth a day = 2025kg DM supply

= This gives a 225kg DM shortfall

• In a period of high growth rate, grass could easily get ahead of you, so this in-balance could be in your favour

• Or to tackle this shortfall, you could alter the supply and demand calculation – can you reduce demand? Equally if supply outstrips demand, could you up the amount needed from grass or take more fields out for silage.

5. How to achieve grazing residuals

A grazing residual of 1500kg DM a hectare should be the aim, although it is not necessarily easy to achieve, but there are a number of ways of encouraging cows to graze effectively.

• Ensure cows are put in front of good quality, fresh grass

• Mowing can be used to reinstate the residual – for example, when a high cover field is not grazed well, it can be mowed down the 5cm to reinstate optimum cover

• When you make a mistake in April, mowing can correct the grazing wedge and have a return on investment. However, doing the same in July, will be purely cosmetic

• Don't put cows into a field above 2800kg DM/ha – she will waste it and then grass will be poor quality

• Cows should go out on the edge of appetite, not with a belly full of TMR

• Select grass varieties with good palatabilities

• Ensure cows go out to something fresh after milking

• Cows not used to grazing may stand at the gate for a couple of days and bellow – don't listen, they will learn to graze, as long as what you put in front of them is quality.

A grass rotation: the basic principle

Setting up a grass rotation works on the principle of rotating stock between paddocks depending on grass growth.

Ideally you want all your fields at different stages of grass growth (some which have just been grazed and others that are ready to be grazed)

This gives you more control over grazing intakes and allows you to achieve maximum grass quality by grazing paddocks efficiently.