**HCC LIVESTOCK SCHOLARSHIP**

# *FORAGE UTILISATION IN SHEEP MANAGEMENT SYSTEMS*

***NEW ZEALAND 2010***

**REPORT PREPARED FOR HYBU CIG CYMRU (HCC)**

**BY**

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## INTRODUCTION

This report is on my scholarship study tour of New Zealand which focussed on how a kiwi sheep farmer manages and utilises forage. The scholarship is funded by Hybu Cig Cymru (HCC) who annually support scholars who want to go abroad and study something that is of interest to them and of relevance to the red meat industry in Wales.

**About me**

I was brought up on a sheep and beef farm in the Cwrt Y Cadno valley in north Carmarthenshire. At home we had between 400 and 500 Tregaron Welsh Mountain ewes and 25 suckler cows and my interest has always been in livestock farming and improving profitability from sheep in particular. I have always been interested in sheep breeding as we sold pure bred Tregaron Welsh Mountain rams from our flock at home. After completing my A Levels I did 4 years at Aberystwyth University where I gained a B.Sc Hons in Agriculture and this included a year's work experience on a sheep and beef farm near Welshpool. After travelling for a year I went back to the home farm and also took part time work on other farms in the area but after a year I decided that the enterprise at home wasn't big enough for me to be there and increasing the size of the farm wasn't a feasible option at that point. I therefore started working on the sheep research flocks at Aberystwyth University and from there I was moved over to the commercial arm of the University which has now developed in to a commercial company and is now called Innovis where I am still employed. My role as operations manager for Innovis includes working on various animal health and breeding projects as well as consulting with and training sheep farmers on various new technological and scientific advancements in sheep breeding.

**Why New Zealand?**

I was fortunate enough to have visited New Zealand on 2 separate occasions previously. The first was when I left college whereby I milked cows for 9 months as well as touring the country. The second was through my work at Innovis where I work with FECPAK, a kiwi company working in the field of internal parasite control. On the first visit although we visited a few sheep farms I didn't get a chance to properly study their sheep systems. However my second visit did involve more visits to sheep farms but the focus was very much on roundworm control. On both visits I got a grasp that kiwi's were farming sheep successfully off a very low cost base system with forage playing an essential role in this. I also realised that they could farm with no financial support system and the market value for their produce has always been lower than ours so I was intrigued to learn more about how they could achieve this.

**Why this subject?**

With CAP reforms resulting in less subsidy payments in the future and the need to reduce the carbon footprint of food production there is a need for the red meat sector in Wales to be more efficient in the way it produces its food. To be more efficient we need to put more reliance on what we can grow well in Wales which is forage. We need to manage this forage better so that it is utilised more efficiently and we need to produce more meat from forage than we are doing now. We need to adapt our systems so that we can grow and utilise forage for longer in the season reducing the need to buy in expensive feedstuffs. Because of the structure of the industry in New Zealand the kiwi farmers have had to adapt to this kind of approach already so there is a lot that we can learn from them.

My interest in genetics and breed improvement has also ignited my interest in this subject. We may have the correct engines for the job but if you miss manage that engine and don't put the correct fuel in then that engine won't perform to its full capacity.

This report includes summaries of my findings from speaking to the various farmers, researchers and consultants on how they manage forage to get the most out of it for sheep production. The report discusses how to grow the forage, what forages are used and most importantly how the forage is managed.

**TRIP SUMMARY**

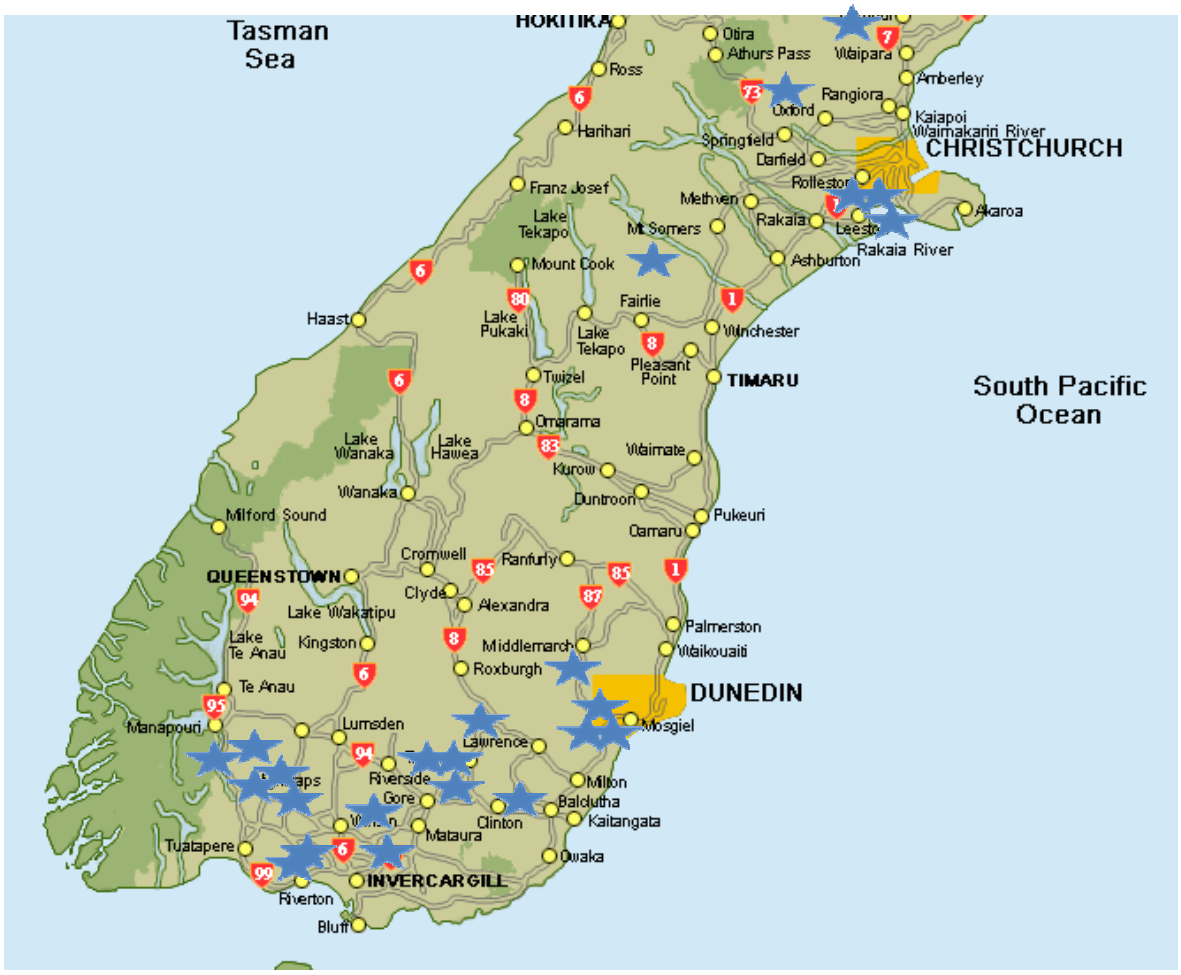
I spent a month in New Zealand between 9th February and 11th March 2010. During that month I undertook the following:-

- 2 days at Southern Field days in Gore, Southland
- 14 farm visits
- 3 Discussion group / monitor farm meetings
- 1 Sheep council open day at Woodland research station
- Met with 4 consultants / consultancy firms
- Visited 6 research establishments / companies

**Where did I visit?**

The map below shows which area of New Zealand I visited. I focussed very much on the lower half of the South Island as this is where climate and topography is most similar to Wales which is important if we are to compare the two systems (see section on climate and forage growth below)

**MAP OF SOUTH ISLAND.** The blue stars indicate each place I visited.



## CLIMATE – COMPARISON TO UK

To properly compare farming systems between New Zealand and Wales we need to discuss the climatic and environmental differences between the two countries. From past experiences many farmers in Wales say that they cannot apply many of the pastoral systems found in NZ as the climate in NZ is far more favourable to growing grass.

The first thing to compare is the position of the two countries on the globe. New Zealand is far closer to the equator than Wales is and to give you an idea if New Zealand was in the Northern Hemisphere it would be at the same latitude as central Spain. My argument to that is how much grass you see growing in central Spain! Being closer to the equator means it is often too hot and too dry for good grass growth and this would be true for parts of the North Island especially.

Even though we are further away from the equator we are sheltered from the Arctic by North Western Europe and Greenland while the South of New Zealand has no shelter at all from the south as there is no land mass between them and the Antarctic so the South Island especially gets the brunt of some pretty hard winter weather. We also have the effects of the Gulf Stream which keep the British Isles warmer than what its position suggests.

As I mentioned earlier I wanted to visit the Southern parts of the South Island (mainly Southland and South Otago) as the climate here wouldn't be too dissimilar to Wales. There were many farms I visited which were within half an hour of some well known skiing fields – we don't get enough snow in Wales to go skiing. From discussions I had with the farmers I met our climates aren't that dissimilar. The annual rainfall ranged between 28" and 80" which would be similar to variance we have in different areas of Wales. I did see a couple of drier farms in the Canterbury area.

Probably the best comparison to make is to look at grass growth. Most farmers said that grass stops growing for around 90 to 120 days in the winter which again is very comparable to us as we don't account for much growth for about 3 to 4 months of the year. If you looked at the grass growth curves for West Wales and Southland they nearly mirror each other.

The more North you go the hotter and drier it gets – this is detrimental in the summer as they suffer regular droughts but they do get grass growth right through the winter which is different to us. However I didn't visit any farms in the North.

In summary although there are climatic differences between Wales and New Zealand the farms that I visited were quite comparable to most Welsh farms and there aren't as many differences as many of us like to think.

**Snow still evident in mid summer**

## SOILS AND FERTILITY

- **SOIL STRUCTURE**

To ensure that pasture grows to its maximum potential, the soil structure must be correct. This is the first part to get right as if you don't have the correct soil conditions and nutrients then there is a knock on effect on all production from that farm. On most of the farms I visited the soil types were mostly clay and sandy loams similar to soil types found in Wales.

The soil needs to be well aerated and not be too compact so that the roots can grow through it. It is common practice for a farmer to dig a square of soil up to inspect it's structure. They are looking for signs of compaction and how deep the roots have grown down the soil. The number of earthworms is also an indication as to how healthy the soil is.

If the soil did show signs that its structure could improve then the farmers would work the ground to rectify this. This may mean deep ploughing especially if the forage species needs to be renewed but often sub-soilers or soil aerators would be employed to break the soil structure below the surface which leaves minimum interruption to normal grazing management.

Draining of waterlogged and heavy ground was important with clay pipes favoured to the plastic piping used more widely in the UK. They favoured the clay pipes (referred to as tiles) because they were porous and had the ability to absorb water themselves, therefore sucking the moisture from the surrounding soils. The farmers believed that these were far more successful than the plastic drainage pipes and they must be a big advantage due to the extra labour of putting the tiles in.

Mole ploughing was also used to improve drainage from a wet field. The mole plough cuts a small channel a few feet below the surface which carries the water away (similar to a Mole tunnel). If a field has been well mole ploughed this could mean a benefit of between 4 – 5 tonne of DM/ ha for crops. The trick is to get mole ploughing correct and this is a difficult thing to achieve as it is dependent on soil and weather conditions. If it's too dry then the mole trenches won't keep formation and structure. If you get lots of rain following mole ploughing then it can be disastrous as you can get massive erosion when water runs through the mole trenches and erodes them in to bigger and bigger water channels and in the end the soil structure collapses. However if they are done correctly then the mole drains can last for 40 – 50 years.

- **SOIL NUTRIENTS**

**Nitrogen**

Although nitrogen is extremely important for pasture growth in New Zealand they are far less reliant on nitrogen fertilisers than us in the UK. As discussed elsewhere clover is vitally important and this is what most farmers rely on to supply nitrogen to the soil through its nitrogen fixing abilities. The advantages of clover over fertiliser N was clearly demonstrated by Doug Edmeades of agKnowledge who calculated that a kg of dry-matter produced from clover N costs 2 – 3 cents while a kg of dry-matter form fertiliser N costs between 10 and 12 cents per kg. The only nitrogen fertiliser that was used regularly on the farms that I visited was for new leys in the first year to help establishment and for brassica crops to help increase yield to ensure enough food is available for the winter. The only other time it would be used was if pasture covers were low due to climatic conditions and they needed a boost in order to meet demand.

**Other nutrients**

Although there is little reliance on nitrogen fertiliser other nutrients are extremely valuable for good grassland growth. Highly fertile soils help plants to persist while low fertility soils will readily convert back to poorer plant species. Most farms would apply phosphorous (P) on an annual basis on all farms I visited and

potassium (K) was also being used as part of a compound on some farms. Sulphur is limiting in lots of areas in New Zealand so this is also included in compounds when needed.

Maintaining pH was also very important and lime was generally spread on an annual or biannual basis which is slightly different to the tradition in Wales of giving a heavier lime application when required at longer intervals.

Soil testing is an important factor of farm management in New Zealand and fertiliser use is always tailored according to soil analysis. There is a cost benefit to applying fertiliser if nutrients are required but it is an expensive commodity if it is not required.

- **FERTILITY TRANSFER**

This is a very interesting concept that I hadn't really thought about until my visit and we don't hear much talk of between farmers in the UK, but most farmers I visited who had slopes spoke of this issue. In big paddocks with slopes sheep always travel uphill to rest / camp and this is where they defecate lots. Therefore by grazing lower parts and defecating on higher parts they are transferring the fertility up hill. This has been proven by carrying out soil tests at the bottom and at the top of fields which showed a big difference in soil indexes' with the upper parts of fields being far more fertile.

When applying fertiliser most farmers would only spread on the lower parts of some fields where fertility is moved from (some may link to GPS in future). Farmers tried to counteract fertility transfer by changing fence lines (e.g. put fence lines along tops of ridges or along contours) or move water troughs to the bottom of paddocks to encourage them to stay there for longer.

The picture on the right demonstrates fertility transfer with the greener area at the top showing the result of sheep transferring nutrients uphill.

## RESEEDING STRATEGIES

**Minimal or no tillage**

Although ploughing and cultivating was still widely practised in NZ to establish a new crop or ley, there was a big move towards minimal or no tillage. This could work in various ways. If a whole new crop was to be established then the existing pasture would be grazed off and sprayed with roundup to kill all of the grass and the weeds. Depending on the field the roundup application may be repeated. After the existing sward / crop has died off the surface is then worked to provide a good seed bed and this is either done by discs, heavy harrowing or a power harrow. The seed is then broadcast or direct drilled in to the bed and may be harrowed again or often a big mob of sheep are walked over it in order to press the seed down in to the seed bed. Sometimes the seed is direct drilled after spraying with no working of the surface.

Before deciding on a no tillage strategy there is a need to establish the soil structure of that field. If the soil structure is good with no capping etc. then there is little benefit to turning the soil over. However if the structure is poor then this would benefit from ploughing or cultivating. Having said that there were examples where farmers preferred to sub soil or use an aerator and then prepare the seed bed rather than cultivate a field.

**Brassicas direct drilled in to an uncultivated seedbed**

The benefits of this minimal tillage reseeding strategy are listed below.

- It greatly reduces the cost of reseeding.
- There is no turning over of dormant weed seeds. This is a massive problem in NZ with thistles in particular causing headaches when a field is cultivated.
- A better surface to graze on in wet conditions. This would be especially true if a brassicas crop is planted to feed in the winter. Cultivated fields don't have a great surface which increases the risk of poaching.
- If done correctly then the results can be just as good as a full cultivation programme.
- There is a positive environmental benefit as far less carbon is released in to the atmosphere under minimal tillage systems in comparison to turning soils over which releases a lot of the carbon that is locked up in the soil.

The other way to avoid too much tillage is to stitch in desired species to an existing sward. This is quite often used to try and increase the clover content of a field if it is lacking in certain areas. The area is grazed off hard before sowing and the seed is direct drilled. Treatment of these fields post drilling needs to be correct with rotational grazing used to keep the original sward down so that it doesn't shade the young clover seedlings. It is also important not to graze too hard as this may destroy the young clover plants.

**Spray and Pray**

For those farming steep county where it was either difficult or impossible to take a tractor on the land due to the terrain, there is a method for sowing called 'spray and pray' which was used for brassicas in particular. All the work is done by helicopters. The existing vegetation is sprayed off and then the seed are broadcast on to the bare soil with a big mob of sheep run over the ground to help bed the seed down. This was very successful judging by the crop of turnips I saw growing on the side of some interesting hills. I saw several examples of this as I was driving around the countryside with lots of steep ground and gullies renovated using this method.

**Looking after that clover**

As mentioned elsewhere in this report clover is vital to farming in NZ so establishing it is important. White clover needs a fine and firm seedbed to ensure the seed is in the top 5mm of the soil where establishment of young seedlings will be at its optimum. If the soil is not consolidated enough then the seed may fall too deep in the loose soil and they will fail to emerge. For good clover growth and development it is important not to sow ryegrass with it at very high seed rates as the ryegrass is very vigorous and competitive.

## FORAGES USED

The forages used in New Zealand are very similar to what is used in Wales with ryegrasses and clover forming the basis of the pastoral system and brassica crops used to complement these especially during the winter.

- **GRASSES**

**Perennial Ryegrasses**

The majority of grasses used in New Zealand's permanent pastures are perennial ryegrasses as they can tolerate a wide range of climatic conditions and management. They are long term pasture options which have good quality and yield well and they are relatively easy to establish as they are competitive (sometimes to the detriment of other sown species in a mix such as clover). For grasses to perform well in New Zealand there is an emphasis to grow well in cooler seasons so that they can extend the grazing season. When choosing ryegrass varieties the heading date is important to suit the farms system and environment. For example early heading varieties are more suited to dry areas where they need the production peak to be before it starts drying and burning off, whereas in summer moist areas can handle later heading varieties.

Popular ryegrass varieties for cool season growth are Extreme, Expo and Ohau as well as Matrix which is a new variety that we have also seen promoted in the UK. If we are to change to trying to make more use from forage then we may need to consider grasses that can contribute to an extended growing season. There was also an emphasis on high sugar grasses and two of these varieties, AberDart and AberMagic have been bred in IGER (now IBERS) in Aberystwyth and these have been widely used in New Zealand. When I was out there I started referring to the Aber varieties as the 'marmite' grasses as farmers either loved them or hated them. Three of the farmers I visited were using them and were getting great results from fattening lambs on swards containing either AberDart or AberMagic due to their increased pasture quality. However there were other farmers I saw that didn't rate them at all and this seemed to be due to their performance during the cooler seasons in spring and autumn. It is probably a case of finding the right variety for your environment and system.

**Italian Ryegrass**

These are very high quality grasses which give big yields but aren't very persistent so they only last between 1 and 3 years in a ley. They also have a long growing season so they are useful in the spring as they do have early spring growth. The farmers I met who used Italian ryegrasses would have it in specialist leys used for finishing in combination with tetraploid or high sugar grasses. In spring and early summer these leys would be used for the triplet mob or thin ewe mob as they provide good feed and energy.

At Mt Linton they had under sown Italian ryegrass with stubble turnips on the steep ground. When turnips are grazed off the Italians re grow and means he gets another year of food from that paddock before having to sow with grass again.

**Diploids and Tetraploids**

All natural grasses exist as diploid (they have 2 chromosomes) but some grasses are bred to have twice the normal number of chromosomes which are tetraploid. These tetraploid grasses have larger cells and therefore larger seeds and leaves and results in a better ratio of cell contents to cell walls so they are higher in sugars which make them more palatable and higher in energy. Again tetraploid varieties are chosen when specialist good quality leys are required rather than long term persistency.

**Endophyte**

Many ryegrasses in New Zealand are bred to contain an endophyte which is a fungus which produces toxins that are toxic to various grass insects and pests such as porina and Argentine stem weevil which can seriously affect ryegrasses performance in New Zealand. There can be a detrimental effect to endophyte as they can cause toxicity to the stock that graze it resulting in health problems such as grass staggers. This is not relevant to us in Wales as we don't have a major problem with grass insects and pests.

**Timothy, Tall Fescue and Cocksfoot**

Although ryegrasses are the most popular grasses these three grasses still have important roles to play in New Zealand's pastoral systems. Generally they are more persistent than ryegrass, they are more tolerant of pests and insects and they are deep rooted which makes them more drought tolerant. They are probably not as high yielding as ryegrasses but they do have good autumn and winter growth which is important. Because they are slower establishing they are more favourable to the establishment of clover.

- **CLOVER**

Clovers are the backbone of the success of pastoral farming in New Zealand and the key is to optimise clover production. Not only is clover itself a high quality feed but is an important source of Nitrogen for the soil which is utilised by other plant species which grow in the same pastures as clover. White clover is the most important and widely grown legume in New Zealand and there are various varieties to choose from that have different leaf sizes, growth patterns, eating quality and persistence.

At the sheep council day I attended in Woodlands Research Centre, Doug Edmeades from AgKnowledge gave a very interesting talk on efficient fertiliser use. In his talk he compared the cost of forage in a clover based system versus a grass and fertiliser N system. Under a clover based system the cost of production of forage was only 2 – 3 cents per KG dry matter while under the fertiliser N system the cost of forage increased to between 10 -12 cents per KG dry matter which gives those who can make optimal use of clover a substantial competitive advantage over those who rely on nitrogen from a bag.

Animals that eat clover have much better performance per KG of dry matter eaten in comparison to those that eat grass. Red clover is also used in short to medium term leys as a high yielding and high protein forage.

Establishing white clover can be difficult and great care is needed to ensure the seed bed is prepared properly and that management of a young sward containing clover encourages its development and competitiveness.

- **BRASSICAS**

Brassicas were mostly used to fill the gap when grass supply fails to meet feed demand – with the most common use being as a winter feed. The advantages of brassicas are that they can provide high yields so only relatively small areas need to be sown to cover a long feeding period. This means stock can be taken off pastures at critical times in the year and allow the pastures to recover and avoid damage. As long as good yields can be achieved brassicas provide a cheaper feed in comparison to the costs of harvesting grass and can lead to improved profitability. A wide range of brassicas are used such as Swedes, stubble turnips, kale and forage rape. Hybrid brassica varieties are also available such as Hunter which is known in the UK as Swift.

The other use of brassicas is as a finishing crop for lambs as they are high in energy and protein so they can maximise growth rates and because they are high yielding a higher stocking rate can be used for finishing. When feeding it is recommended that a supplement be given to provide fibre for the diet (e.g. hay, straw or a run off of standing pasture) particularly in mid to late pregnancy.

Brassicas are also an important factor in the rotational system as they provide a break from pastures and can decrease pest and weed problems. With the use of fertiliser growing a brassica crop can help correct fertility levels in the soil.

- **CHICORY**

Chicory is a perennial forage herb and was used by several of the farmers I visited as part of a pasture mix. It gives high dry matter production and is of very high nutritional value which makes it a good forage to fatten lambs on and it tended to be used in those specialist finishing leys together with clover and high sugar or Italian ryegrasses. It is also believed to have an effect in limiting the effects of intestinal parasites on lamb growth and it has been proven to reduce faecal egg counts. Chicory can be used either as mix in a grass / clover pasture or as a specialist crop on its own which was less common. It has the added benefit of a deep tap root which means it has an elevated mineral content and it grows well in drought conditions.

- **PLANTAIN**

Plantain is derived from a weed which we also have in the UK. It grows well in low fertility and shallow soils and you will often see it growing on the edge of tarmac / or gravel. It is also very good in high rainfall but does not have such good growth in drought conditions but it will stick it and stay there and when the rain comes it will flourish. Plantain also has a very good mineral content so it is good for stock health and it may also have some anthelmintic properties. Used by quite a few farmers in New Zealand it is very good for growing stock, especially until weaning. The problem is that thistle sprays will also kill off plantain but if plant breeding techniques can breed a variety that survives thistle treatment, then I can see a place for plantain in the uplands and hills of Wales.

- **LUCERNE**

Lucerne is a legume and it grows well in dry conditions as it has a deep tap root and is a good feed for fattening lambs on and was an essential forage in the dry regions I visited such as central Otago. Because it is a legume it also has a role in fixing nitrogen. Although I don't see a widespread application for it back home there could be a place for lucerne on farms that are dry and tend to burn up in the summer.

## PESTS AND WEEDS

New Zealand doesn't have some of the pests we have to contend with such as moles but they do have some that we don't have which can devastate a pasture. The worst of the pests would be Porina, Grass Grub and Argentine Stem Weevil which eat away at the tillers, growing point or roots of plants and they can be particularly devastating especially to ryegrasses which are prone to attack. Several farmers I spoke to have had difficulties especially with Porina. They don't affect some grass species such as tall fescue and Timothy and ryegrasses can be treated with endophyte to help protect them.

- **THISTLES**

This is an area where us Welsh farmers may be better at controlling than our kiwi counterparts! I certainly saw plenty of thistles on my travels around New Zealand – they were a real problem for grassland farmers. Part of the problem is that many farmers aren't keen to use chemical sprays on their farms as it will knock clover back and also kill other sown species they may have such as plantain and chicory. I did go on farms where weed wiping had worked well using roller or carpet brushes similar to what we use in the UK. According to some farmers every time you turn soil you turn up dormant seed which blights the next crop and was one of the reasons why some farmers preferred no tillage reseeding.

There is a method of reducing thistle infestation in a field just by a series of topping followed by hard grazing when the re growth appears. The idea is that a large mob of sheep are put on to a field when the thistle plants are still at a young stage and are therefore palatable. If sheep graze these off, there is a good chance they eat out the growing point and reduce the number of thistles. For this to work effectively an extreme stocking rate is needed for a few days and would need to be repeated later in the season.

There is ongoing research for thistle control. At AgResearch there is a project looking at exploiting fungal pathogens that kill Californian thistles (which is the most difficult to control). This pathogen is found naturally in the environment and its spores are dispersed by rain splash. The project is looking at the effect of topping Californian thistles in the rain with the theory being that the topper damages the plant and the rain splash will carry the spores on to the damaged areas of the plant where it can destroy it. Anecdotal evidence already suggest that farmers get better results from topping thistles in the rain but the project is still ongoing so the results are not yet available.

- **WILD TURNIP**

This can be a particular problem when growing brassicas as it is a brassica itself so herbicide control is not an option. Even though it is a brassica it is undesirable as it is of low quality and competes with the planted brassicas so decreases yield. The only option with this weed in a brassica stand is to pull it out by hand and a few farmers I met had this resolved as they got the local school children to come and do it!! (I should add here that the farmer did have to make a donation to whatever the kids were trying to raise money for just in case you thought they were taking advantage of child labour!).

Double spraying and growing break crops can help control weeds, pests and diseases.

## MAXIMISING PASTURE GROWTH BY MANAGEMENT

Many things affect pasture growth such as the soil structure, fertility and plant varieties which are discussed above. However growth is also influenced by the management of those pastures. Grazing management can affect both the quality and the quantity of the pastures. If a pasture is overgrazed then growth will be slow because of the low leaf area, to grow leaf, the plant needs energy and it gets that energy from the sunlight which is intercepted by the leaf - 'leaf grows leaf'. On the other hand if pastures are under grazed then growth and quality suffers as there is high level of leaf death. The kiwi farmers are very aware of this and aim for optimal grazing. For sheep, the optimum pasture mass for grazing is between 1,000 and 2500 kgDM/ha which equate to an approximate sward height of between 2 and 7 cm in the summer. For cattle grazed pastures the optimum is higher at between 1,500 and 3,000 kgDM/ha.

There were two main types of grazing management systems in New Zealand which are continuous / set stocking or rotational grazing. In systems where set stocking is used the sheep are set stocked at certain times of the year and do not move from field to field, this is ideal when pasture growth is high and will result in maximum animal intakes. The key to set stocking is to ensure the pasture mass stays inside the optimal range discussed above. With rotational grazing the animals shifted from field to field in a rotation – the length of which depends on the time of year and stock type. With rotational grazing there is better control over animal intakes and is practised when pasture growth is lower and also helps with maintaining the quality and quantity of pastures.

During wet seasons it is important to avoid damage to the pastures and soil structure by poaching / pugging. The damage occurs by the stock destroying the tillering point of grasses or burying the growing point of a clover plant in the soil. If this is excessive then bare patches occur in a field which not only decreases yields but allows entry points for weeds to establish and grow. When conditions aren't favourable then this damage can be minimised by the choice of field that is grazed during that period and shifting the stock more often. There is also an emphasis on maintaining the structure of soils as discussed previously.

**TOPPING PASTURES**

This was common practice on a lot of farms but most acknowledged that mechanical topping to keep on top of pastures was expensive and not always cost effective.

*"The best topper you can get are the ones with 4 inch blades"* Consultant Alastair Gibson referring to using cattle as toppers.

If grass has got too long the rubbish that they leave behind after topping can cause problems. If there are lots of it, it will just shade and smother any new growth trying to get through. Also the dead thatch left in the base of the sward can have a fungus growing in it that releases zearalenone that can cause problems with reproductive performance.

To try and avoid this, farmers may turn cattle or ewes in to the field straight after cutting to eat the toppings. In extreme cases it has been known to bale the toppings just to get it off the field to let the fresh get through. The best thing is to ensure grass doesn't get this long in the first place.

"Top early in the summer for quality – topping late in the summer is only for cosmetics" Chris Adams

A lot of the topping here is done early on in the season – this ensures the grass doesn't go to head and start losing quality. By ensuring stems are cut before seed head production you encourage more tillering as this is the plants response to try and reproduce. Some farmers I met topped some paddocks three times a season. This season has been a particularly difficult one to manage as there were three periods in the season where grasses went to seed. Once farmers see ryegrasses start waving in the breeze it is getting too long and they need to do something about it. Keeping grass swards relatively short also helps minimise the shading of clover and means that there is a good proportion of clover in the sward. Where possible topping is done by a mower rather than a conventional topper as it gives a cleaner cut and doesn't thrash and damage the plant so much.

**CHEMICAL TOPPING**

This was a practice that used to be common in New Zealand but only one of the farmers I met was using this approach. When it works well I can see this as being a useful way of increasing the proportion of the desirable grasses in a sward so it improves pasture composition without the expense of reseeding.

Chemical topping involves spreading roundup at ¼ or 1/3 rate and this gets rid of the older / weedy grasses as well as thistles. Because ryegrasses have a smooth leaf then this low application of roundup doesn't stick to the leaves. A high application of roundup is needed to kill clover. This picture is of an old pasture which now has ryegrass and clover thriving following chemical topping.

**EXTENDING THE GRAZING SEASON**

This is one of the main goals of all pasture farmers in New Zealand. Every effort is made to prolong the growing season - some reckon they can get 2 / 3 weeks extra growth at each end of the season just by better management. If they can get this additional 4 to 6 weeks of growth it is invaluable to the farmers as it can shorten winters by between 23% and 35%.

How to achieve this?

- Improve drainage of the soils – this reduces water logging and therefore means soils are warmer for longer in the autumn and warm up earlier in the spring – this encourages grass growth. Either full drains would be put in or often mole ploughing would be used (see section on soils above).
- Ensure the right cover is on the fields in the spring. Too much cover carried through the winter means high levels of leaf death and if this is excessive then there are clumps of dead material which stops new re growth. If pastures are overgrazed then there is not enough leaf to trap the sunlight which a plant needs for growth and means growth will be slow.
- Choosing the correct varieties for good growth in cool seasons, a lot of emphasis is put on this when breeding new varieties.

**CREEP GRAZING**

I learnt about this from Tom Fraser from AgResearch who had been working on this idea on some of the research and monitor farms. This was a very interesting concept that encouraged lambs to eat the best forage and get maximum growth rates. It is very similar to our creep feeding of concentrates but uses grass instead of concentrates. Creep grazing of lambs is a system where lambs are allowed to graze the better pastures in front of the ewes in a rotation using a creep gate. The ewes would then follow around after the lambs and eat the rest of that pasture out while the lambs had access to the next field where they get the first and best pick.

There was a gain of about 3 to 5kg in lambs weaning weight when it worked successfully but it hasn't been widely adopted as there were practical problems with getting the lambs going through the gate which they are working on. It did work better on flatter lower ground where the lambs could find the creep gate easily and were still in view of their mother but was less successful on hill ground due to the land contour and larger paddocks. In the ideal system there would be 6 paddocks to rotate and the lambs and sheep shifted every 4 days. Lambs will be back in same pasture again after 21 days so to get the system to work you need a field set up to accommodate this.

Apparently this used to be practiced in Wales years ago – it would be interesting to see if this could have an application now.

**MAXIMISING UTILISATION**

In order to be efficient the goal of the kiwi farmer is to use as much of what he has grown as possible. Even though their management in this respect is very impressive to me and I think that utilisation of forage is probably better in New Zealand than in the UK, Tom Fraser from AgResearch was of the opinion that even kiwi farmers can improve their utilisation rates. He has calculated that farmers he works with, utilise about 60% of what they grow and he thinks that they should be utilising between 70 and 80% of what they grow if they were going to be really efficient.

**Minimising dead matter in the base is crucial**

## FEED PLANNING AND BUDGETING

To achieve an efficient forage system there is a need for careful planning and budgeting. As I have mentioned elsewhere most farmers I met had some kind of feed budget for the autumn, winter and early spring and this would vary from a rough plan on the back of an envelope, a more detailed spreadsheet exercise or using a specially designed computer programme. The key times when a proper budget is required is when feed availability is low and will struggle to meet the feed demand from the stock present during that time which would be over the winter when there is hardly any grass growth. The planning also needs to cover the preceding autumn as management at this stage is key to ensure there is enough feed at the start of winter to carry through and this is at a time when grass growth is slowing down.

They key elements of feed budgeting are:

- Is there enough food available to operate over the period in question (normally winter)
- What is the best way of feeding that out to meet feed demand, maximise utilisation and promote future pasture growth

**EXAMPLE OF A FEED BUDGET**

The following is an example from consultant Graham Butcher of Rural Solutions Ltd.

Budget from 1st May (1st Nov in UK) to set stocking ewes on 10th September (10th March in UK) = 133 days.

| **What feed is available:-** | **KgDM Total** |
|---|---|
| • 180 ha grass with 2,000kgDM/ ha average cover | 360,000 |
| • 180ha growing grass - at 5kg DM/day (only 50% is available) | 59,850 |
| • 15ha crop at 11,000kg DM /ha @ 85% utilisation | 140,250 |
| • 120 bales of balage at 220kgDM @ 85% utilisation | 22,440 |
| • Extras (e.g. run off – gullies etc.) | 5,000 |
| **Total feed available:-** | **587,540 kg DM** |

Notes:

- Only 50% of growing grass is available, as when stock are rotated half of the grass that grows is growing behind them in the rotation so it is not utilised.
- An utilisation figure is used for crop as some is wasted. For grass it is assumed that hardly any is wasted as what is left behind counts towards the residual in the field which is what contributes to the first cover of pasture in the spring. If it is a particularly wet and bad season then you may account for 85% utilisation but even grass that is trodden in to the ground can recover by spring as long as it is managed correctly.

| **What feed is needed:-** | **KgDM Total** |
|---|---|
| • 1250 ewes @ 1.2 kg DM / day for 133 days | 200,000 |
| • Pre lamb lift @ 1250 ewes @ 12Kg DM additional* | 15,000 |
| • 350 hoggets @ 1.2 kg DM / day for 133 days | 56,000 |
| • 145 calves @ 3.8 kg DM / day for 133 days | 73,000 |
| **Total feed demand:-** | **344,000 kg DM** |

*For the pre lambing lift the 12Kg DM / ewe additional would be spread over a period and would rise steadily over that month. For example the pre lambing lift would start 1 month pre lambing – starting at 0.1 kg DM / day (additional to maintenance) to 0.8 kg DM / day (additional to maintenance)

| | |
|---|---|
| **FEED LEFT OVER = FEED AVAILABLE – FEED DEMAND =** | **243,540 Kg DM** |
| **FEED LEFT OVER / Ha (spread over 180 ha of grass)** | **1,353 KgDM / ha** |

The feed left over is what's called the grass residual which is essential as you need some pasture covers at set stocking so there is enough grass there until it starts growing in spring. The cover left should also mean that there is enough leaf area available to capture the early spring sun so it gets energy to start growing. This farmer would have to question if 1,353 kgDM / ha was enough cover for him to set stock on? This will all depend on his stocking rate and some farmers feel they need higher pasture covers at set stocking (e.g. 1500 – 1800 KgDM/ Ha).

For example if a farmer has a stocking rate of 10 ewes per ha (4 ewe per acre) at set stocking and these ewes are eating 2kg DM per day (as they are in late pregnancy) then 20 Kg of dry matter per ha will be eaten per day. At covers of 1,353 KgDM/ha only about 353 Kg DM/ ha is available because covers below 1,000 kgDM/ha looks like virtually nothing and sheep can't get enough intakes when covers go below this. So at a usage rate of 20 KgDM / ha there is enough food there for about 17 days if grass doesn't start growing.

The above example is a simple way of calculating a budget assuming animal demand in terms of intakes of dry matter only. More complex but more accurate indicators of demand are calculated by using metabolisable energy (ME) estimates and is measured in mega joules (MJ) of ME . This would obviously differ depending on age, stock class, stage of production and time of year etc. E.g. a 60 kg ewe on rolling / easy land on maintenance requires 9.6 MJ ME / day while the same ewe in late pregnancy (2 weeks before lambing) carrying twins requires approximately 16.2 MJ ME / day. You then need to know the ME content of the feed you are using so that you can then work out the dry matter required. For example if the ME content of the pasture they are grazing is 10.5 MJ ME / kg DM then the 60kg ewe at maintenance requires 0.9 kg DM / day (9.6 MJ divided by 10.5 MJ ME / kg DM) and the same ewe 2 weeks before lambing requires 1.54 kg DM / day (16.2 MJ divided by 10.5 MJ ME / kg DM).

The next step in the budget (after calculating the feed availability and feed demand) is to work out how best to feed it out. To do this you need to know the following:-

- Mob size
- How you would like to feed them (e.g. 1 day v's 4 day shifts, behind hot wire or paddock at a time)
- The size of the paddock
- The pasture cover in that paddock
- What residual will be left after grazing

**EXAMPLE OF FEED ALLOCATION**

These are 3 different paddocks grazed at different periods in the winter by mixed age ewes.

| Paddock | Area (ha) | Cover Kg DM / ha | Residual Kg DM / ha | Total Available DM | Intake Kg DM / ewe / day | Days in Paddock | Actual days in paddock |
|---|---|---|---|---|---|---|---|
| 1 | 8.84 | 1750 | 600 | 10166 | 1.2 | 5.29 | 5 |
| 2 | 3.8 | 2259 | 700 | 5924.2 | 1.4 | 2.64 | 3 |
| 3 | 5.54 | 2402 | 800 | 8875.08 | 1.6 | 3.47 | 3 |

Notes:

- The residual means the amount of grass you want left in that field after grazing and this residual can be lower at the start of a rotation as these will recover slightly before the end of the winter with the minimal winter growth that there is, while towards the end of the rotation there is less time for

pastures to re grow. Another factor to bear in mind is that if you leave low residuals you are forcing the sheep to eat the poorer quality component in the sward which will suffice in early winter when they are in early pregnancy but is not desirable in later pregnancy when they require quality as well as quantity.

- The Total Available DM is calculated as:- (Area X Cover) – (Area X Residual)
- Ewe intake increases as we get in to later pregnancy
- Actual days in paddock can be rounded up in the early parts of the rotation but should be rounded down in the latter parts of the rotation
- Now you know how many actual days you can get out of each paddock you can divide the paddock up using electric fences depending on which feeding regime you are using.

**Always have a backup plan.**

The budgeting system does have to take in some assumptions and things don't always go according to plan as a lot depends on nature and the climate. It is important to have a plan B if plan A strikes a glitch. The beauty of budgeting and working those budgets out early in the winter is that farmers will have a fairly good idea if there is going to be a feed shortage relatively early on. For example there are target covers at key stages such as the first day of autumn and 1st day of winter and if the pasture covers haven't met targets on the first day of winter then they know they will have a shortage in the winter. This allows farmers to carry out adjustments to the system which could be any of the following:-

- Purchasing feed such as grain / silage or a standing crop such as brassicas
- Selling stock that are saleable – e.g. dry hoggets, selling cattle as stores rather than fattening them
- Sending some stock away for wintering
- Restricting intakes to other stock on the farm is feasible. E.g. if there are dry cows that are in a stage where it doesn't matter so much that intakes are reduced.

Having a budget means that farmers can act far sooner in periods of feed shortages rather than just running out of food in late winter and dealing with it then.

There are various computer programmes available such as 'FeedSmart' and 'PastureCoach' which aid farmers in the feed budgeting and planning process.

## MONITORING PASTURES – MASS & QUALITY

For feed budgets to work there is a need for an assessment of the amount and quality of feed that is available on the farm. There are a variety of ways that farmers do this;

**MONITORING MASS**

The mass of a crop is measured in Kilograms of dry matter (Kg DM) and is usually expressed on a per hectare basis.

**Pasture**

The most accurate method of measuring the mass of a pasture is to cut a known area off at ground level and then wash it, dry it overnight in an oven and weigh the dried out sample. This however does not lend itself well as a regular on farm measuring tool and therefore the farmer would use one of the following methods of assessment.

- **Visual assessment.** This depends on the farmers experience and they will just eyeball a field and assess how much cover there is in there. There is obviously a large scope for error here but it is better than not doing any assessment and even if the assessments are inaccurate the farmers are at least thinking about it. To aid visual assessment, many farmers I met would simply walk through a field and assess how far up their gumboot (wellingtons for us!) it comes or use a standard object such as an empty beer bottle to assess covers (e.g. if it comes up to bottom of label its 1500 kg DM / ha – if it comes halfway up label its 2000 kg DM / ha). Another farmer I met used his hand and measured how many fingers high the grass was. Many would use a plate meter or pasture probes on occasions to calibrate their visual assessment. The advantage of visual assessments is that the individual can easily make adjustments for variation in the sward such as composition and dead material and it is also the easiest and quickest method so it is likely to be used more.

- **Rising Plate Meter.** Many readers will have seen dairy farmers using this tool. The plate meter is a circular aluminium plate which is plonked on the ground at regular intervals during a walk of the field. The height at which the plate rises up the centre axel is recorded and this is used to assess how much pasture is under the plate. There are calibration equations used to convert the height of the meter in to Kg DM and these will vary depending on the season and pasture content as these will have an influence on dry matter percentage.


- **Pasture ruler or sward stick**. This simply measures the pastures height in centimetres and there is a simple table to convert this height in to kg DM / ha which is often written on the ruler itself. Again there are different conversions for different seasons. These rulers are available in the UK and are normally given free from a seed or feed company.

- **Pasture probe**. This is a handheld device that looks like a white walking stick. One of the limitations of the probe is that it can give inaccurate readings depending on the amount of water on the pasture and the dead matter content. Measurements are stored electronically and this also works out the mass and can be downloaded onto a computer.

- **Rapid Pasture Meters.** These were new tools that were available for monitoring pasture mass. They were either mounted on the front of a quad bike or trailing behind a quad. Sensors were used to estimate the amount of grass as they were passing over and this was collected and stored in a computer which also calculated the mass. This allowed lots of measurements to be taken and was very easy as all you had to do was drive across a field and it would provide readouts. Some of the equipment I saw were linked to GPS so that it automatically recognised which field the readings came from. I didn't meet any sheep farmers with these tools but they are very new and have only just started to be used by a few dairy farmers.

**Brassica crops**

To measure the mass of a brassica crop a 1m by 1m square would be measured out and all of the plants within that square are pulled up and weighed so that the fresh weight per metre square is recorded. A sub sample is then sent off for analysis (also see quality below) to give the dry matter % of the crop. From this the dry matter mass per hectare can be calculated.

**MONITORING QUALITY**

The most important elements of feed quality are metabolisable energy (ME), digestibility, fibre and protein content.

The most accurate way of measuring the quality of the pasture was to send samples away to a lab for analysis. This would give detailed readings on what is needed to ensure the pasture will provide the animal with what is needed. This is used for brassicas crops but is less widely used for pasture although I did meet some farmers who did send pasture samples for analysis.

Most farmers would make an informal assessment of quality which would take into consideration some of the following factors:-

- Greeness
- Amount of stem v's leaf
- Presence of seed head
- Clover content
- Amount of dead matter in sward

There are computer programmes available for farmers in New Zealand such as the 'Q-Graze model'. This programme would use the visual assessments listed above as well as climate information and time of year to predict the quality of the pastures. It also uses information such as type and age of stock and stocking rate to predict intakes and animal performance.

## GRASSLAND MANAGEMENT THROUGHOUT THE YEAR

The best way to describe how the kiwi farmer manages grass is to break it up in to the different periods of the year and explain how different farmers approached these.

- **AUTUMN TO EARLY WINTER**

As well as maintaining feed levels to stock during the autumn the goal here is to start the management process to ensure adequate feed throughout the winter leaving enough cover for the following spring. A rotational system would be used so that intakes are kept at optimum levels and the rotation is extended to start building a feed wedge ready for the winter. Sheep would start to be fed behind an electric fence or 'hot wire' to ensure they don't use up too much grass that is needed for the winter but enough for their maintenance diet. Most farmers would calculate their budget at this stage and quite often an assessment of pasture cover will be made. As the winter approaches they have a good idea of how much feed they have got and will work out how much to allocate for each day. At this stage there are target pasture covers to meet – for example on a farm where only grass is fed during the winter there may be a target cover of 2,000 kgDM/ha on the first winter while on a farm which are more reliant on brassica crops for winter feeding the covers may be as low as 1,000 kgDM/ha at this same stage.

- **WINTER**

The areas of New Zealand where I focussed my visit on have quite hard winters and generally they have no or limited grass growth between 90 and 120 days which would be very similar to the situation in Wales. This is therefore the critical period for ensuring enough feed availability for livestock. On the farms I visited the feed that was used in the winter was either brassica crops, conserved pasture from the autumn or a combination of the both. Where brassicas were grown this was often supplemented with silage and / or straw however I did meet some farms who offered no supplementary forage with brassicas but these sheep would have to be back on the grass rotation at least 6 weeks before lambing. Utilisation of the feed is key here as they don't want to waste any feed at this stage of the year. Most sheep are fed behind the electric fence and the majority are on one day shifts so there is a lot of work involved in moving electric fences – one farmer I met had to move between 14 and 16 electric fences per day in the winter between the sheep, cattle and deer.

The weather can get very wet in the winter so sward and soil damage is a risk. If conditions are bad fences may be moved twice a day to ensure stock have a clean place to stand and lie on.

**4 day shifts**

There was a lot of discussion about changing to 4 day shifts for winter feeding when I was out there. Several farmers have trialled this technique and the results so far have shown:-

- Sheep are more content and settled – they don't walk around so much – e.g. on 1 days shifts every time sheep hear a motorbike they are up and walking and want to be moved.
- Improved winter feeding
- Easier winter shifting regime – less labour intensive
- Less pasture damage – suggestions of better regrowth

The target at the end of winter is to ensure pastures are in a good state for spring growth and there is enough cover to go in to spring.

- **LAMBING TO WEANING – SPRING & EARLY SUMMER**

In the Southland and South Otago regions where I visited, the date every farmer looked forward to seemed to be the 20th of September which is the date they can depend on the start of spring growth. Many farms tried to ensure that grass started to grow as early as possible in the spring.

Pre lambing sheep are set stocked across the farm in preparation for the lambing season. They can be set stocked between 3 and 1 weeks pre lambing depending on the system. The rate at which they are set stocked depends on the litter size they are carrying. Most of the farms I visited would pregnancy scan but very few would scan for triplets as anything with 2 or more lambs would be managed the same.

Most farmers I visited would keep sheep set stocked until weaning as this was easy on the management of the farm and it worked well as in general grass growth would be more than feed demand so the sheep would be eating maximum intakes so that they grow to their full potential. Some farmers would set stock until tailing and then start a rotation system. If set stocked until weaning there would be a need to balance out the stocking rate in a field if the grass is getting short in one and there is excess in the other (e.g. they may move 5 set of twins from 1 to the other) and this has become known as the 'Southland Shuffle'.

If needed it was common practice to top fields to help ensure grass quality and stop seed going to head (see section on topping). As soon as grass started waving in the breeze it needed to be topped.

- **WEANING TO MATING – SUMMER AND EARLY AUTUMN**

Most farmers would wean and move the weaned lambs back to the fields where they come from for about a week. This means the lambs go back to surroundings they are familiar with (e.g. they know where the water troughs are) and this minimises stress after weaning and the post weaning check.

In post weaning the norm would be to rotationally graze the lambs in some fashion. Some farmers would have a strict rotation – for example they would be in a field for 3 to 5 days and then shifted to the next fresh field. This rotation may be between 12 and 20 days long. Others may have a system where they have 4 or 5 fields open to the lambs – after a few days they may open a new fresh field for them and close one field they have been in to freshen up and shuffle around.

The aim is for maximum post weaning lamb growth rates and the biggest lambs that are closest to selling get the preferential grazing (those fields with high sugar grasses and good clover content – young leys etc.). Lambs are always lightly stocked now as well so that they get plenty of pick of the grass. Once lambs have grazed 50% of a field out they are moved on to a new fresh field. Finishing lambs are never left to graze a field out – if they do this then growth rates will suffer as lambs will be forced to eat out the poorer parts of the pasture. For example in the UK I see it as normal practice to turn lambs in to a field of nice grass and they may not be moved until they have finished that field off. If this would take 10 days then for first 5 days the lambs will be picking out all the nice juicy bits of the pasture which is really good for them as these will be the most digestible and the better quality so growth rates should be good. However for the last 5 days there won't be as much of the good stuff left so they are being forced to eat the least digestible and stemmy parts of the sward which would result in a dramatic reduction in their growth rate. By moving the lambs once they have eaten the best 50%, this ensures the lambs are maintained at their maximum growth rates.

After the lambs have been moved the pasture is either left to grow and fill out again 'freshen up' or if it is starting to lose quality (lots of stem content) a big gang of dry ewes would be turned in to clean the field out. You will see from these pictures how ewes are used to clean the field out – they are put on at very high stocking densities and eat it right back including any dead material so that new fresh re-growth will follow.

**The field on the right has just been cleaned out by ewes and the one on the left is fresh re-growth after cleaning out.**

## CARBON FOOTPRINT

This is starting to play an important part in New Zealand agriculture and there were lots of debate around this subject during my time there. Like all other countries in the world, New Zealand has targets to reduce its carbon footprint. This will probably have a bigger impact on agriculture in NZ than in the UK as the percentage of emissions from agriculture is far greater due to the smaller population and it is has such a large influence on the economy of the country. For example New Zealand's greenhouse emissions is split in to 49% from agriculture, 43% from transport and energy and 8% from industrial processes and waste. There are 10 times more sheep than humans in New Zealand which makes them the only developed nation needing to focus more on the countryside than the cities.

**Emissions Trading Scheme (ETS)**

This is a government scheme which encompasses all greenhouse gases across all sectors. The forestry sector is already in the scheme and other sectors will enter the scheme over the next few years with agriculture being the last to enter in 2013. The scheme basically puts a price on emissions of greenhouse gases and provides incentives to lower emissions. Each farmer will be given carbon credits which relate to the size of the farm and type of land they have. For example landowners will gain credits from planting trees that will act as a carbon sink, reduces soil erosion and improves water quality and the landscapes. Landowners can then trade in carbon credits and this would be encouraged rather than commercial cutting and milling of trees.

**How to reduce the carbon footprint**

The main drive behind reducing emissions from agriculture in New Zealand is to increase efficiencies. The focus is on how much emissions there are for every unit of food produced. For example the easiest way to reduce emissions per kg of lamb is to improve output without increasing inputs. The driver is to increase number of lambs per ewe, increase kg lamb per carcass and increase stocking rate. If more Kg of lambs can be produced per ha of land with no increase in inputs then the emissions per kg of lamb are reduced. The other part of the work is looking at decreasing inputs and minimising wastage. Decreasing inputs such as fertiliser and chemicals has always been crucial and this has been aided recently by the use of GPS tracking systems when applying these inputs. Analysing soils so that the farmers only apply what is needed is also important – fertiliser is a significant contributor to greenhouse gas emissions.

Improved utilisation of the herbage that is grown will reduce emissions. Growing grass and crops as well as being expensive has a carbon footprint cost to it as well. As discussed elsewhere if farmers can use more of what is grown and waste less then that will reduce a farms carbon footprint. Increasing herbage utilisation from 60% to 75% will have a significant impact on reducing emissions.

As discussed under the 'reseeding strategies' section, minimal or no tillage reseeding strategy is advised. When soil is turned over, lots of the carbon which is stored in the soil is lost to the environment so it is best to avoid this.

**Food miles debate**

This has sparked much controversy on the impact of food production on the economy within the UK in particular using the number of miles to get food to the plate as a marketing advantage, claiming that home produced food is better for the environment than food that is imported from countries such as New Zealand. Worryingly for us AgResearch has show that only 2 to 3 % of greenhouse emissions are generated by the transport of food from New Zealand to the UK (this example used butter). It is very interesting to note that the production of the food on the farm has a far greater impact on emissions than shipping it across the world. Since this analysis was done the NZ industry is focussing on what happens on farm rather than the transportation of the food, as this is where they can get most impact.

We must be cautious when making bold claims about food miles. We must remember that the majority of the sheep industry is reliant on concentrate feeding with most farmers using concentrate to feed the ewe in late pregnancy and lactation and most of the lamb sold up until July is based on a creep fed concentrate. This concentrate comes at a heavy carbon footprint cost. Since fishmeal has been banned from livestock feeds the source of high quality protein in concentrates is now soya. Most of the soya used in concentrates is grown in South America so there are similar issues with food miles to get the stuff we feed our sheep with over to the UK and there is the added impact of deforestation of the rainforest to reclaim land to grow soya.

If we compared the emissions of lamb production in the UK and New Zealand then I don't think we are currently in a strong position, even when food miles are included due to the efficiencies of pastoral systems in NZ and the comparatively inefficient systems in the UK with these inefficiencies having been driven by subsidies.

**Measuring carbon footprint.**

This can be a little ambiguous as the science behind how much carbon and emissions are related to meat production is still debated with so many areas of the supply chain being difficult to measure. AgResearch are undertaking work where the emissions from different types of soils and pastures are captured and measured and will provide baseline data for the industry.

At Abacus consultants I learnt how they are working on a computer system of measuring the emissions from lamb production. The idea is that this information can be used to help farmers find ways of reducing their footprint which shows they are well on their way to help farmers tackle this issue. The system is based on computer modelling and will have to rely on assumptions for many of the calculations.

The important thing for me is that everyone uses the same measurement and modelling systems if we are to compare different livestock and husbandry systems and this should relate to a worldwide scale.

## MEAT EATING QUALITY

As well as the quantity of meat produced, the eating quality of that meat is also important to NZ lamb production. Because lamb production is all pasture based it is believed that this has a benefit on the meat eating attributes of lambs and I didn't see any work being done to improve eating quality on farms by the use of grazing management. However at the Woodlands field day I attended there was an interesting talk on eating quality by Murray Behrend from the Alliance group. Alliance (who are one of the largest meat processors in the country) had been working on a project investigating meat eating quality. They were looking at all aspects of meat quality, such as meat colour, tenderness (frozen and chilled), pH, aroma, flavour, texture and content. They were looking at genetic correlations for the above traits and found that the redness and brightness of meat had quite high heritability and that pH and tenderness had medium heritability so could be selected for in a breeding programme.

One of the outcomes of the project were that slower growing lambs generally had better overall eating acceptability with better aroma, flavour and succulence. Faster growing lambs had paler colour meet which made it less attractive to consumers. This begs the question does new season lamb we produce before July have poorer meat quality attributes seeing as they are forced to grow quickly through the use of high quality concentrates? The project also compared different pasture types but other than red clover having a negative effect on colour there was no other correlation with meat quality.

Another interesting outcome was that there was no difference in meat quality between rams, castrates and crypts (a different form of castration) as long as they were killed before 12 months of age. Rams had better yields than castrates and crypts which questions the need for castration of lambs.

The desired outcome of the project is that Alliance would like to see a system for paying farmers on meat eating quality as well as meat yield in the future.

## NEW DEVELOPMENTS FOR THE FUTURE

- **FERTILISING BY GPS**

Some of the new things to see at the southern field days included a GPS mapping system fitted to the fertiliser trucks which were probably on 70% of fertiliser spreaders in NZ. These show the driver in the cab his current position as well as what parts are already spread. This has cut back fertiliser usage by minimising double spreading and the farmer gets a print out to show exactly where the contractors have put the fertiliser and exact application rates. These are commonly used in our arable industry and I have learnt since coming back that some contractors use them when fertilising. There may be a place for more widespread application of this technology to ensure correct application of fertilisers and minimise wastage.

- **SOIL ANALYSIS BY GPS**

This is taking fertilising by GPS to a new level. First of all a detailed soil map of the farm is produced and this is done by driving over all the fields with a set of discs which cut into the soil. These discs somehow measure the soil type they are driving over (e.g. heavy, light, sandy, clay etc.) and the position of each type is automatically logged by GPS. This is downloaded on to a computer which combined this data with soil analysis results. The farmer will then work out fertiliser requirements with his consultant / fertiliser representative and this data is also fed into the programme. When the contractor comes to spread the fertiliser this information is transferred to the onboard computer which then controls the application rate according to which part of the field it is driving over. This gives a very accurate and optimal application of fertiliser and although it isn't widely used in the sheep industry, several farmers I met were interested in its application. This sounds like a very expensive piece of technology but it did seem quite reasonable especially when you consider you only need to create the map once as the information is stored for a lifetime as the soil type wouldn't alter.

- **SOIL ADDITIVES**

One of the companies I spoke to at the field days offered a soil testing service for humus content and soil microbial activity. These are important for nutrient and mineral breakdown and uptake by plants so it is important the soil is in the correct condition. The company also provide additives that can be applied to the soil to address any problems. These additives include organic humates and fish and seaweed extract. This would be important where field performance isn't what it should be.

## CONCLUSION

This report is an attempt at summarising my visits which was a difficult task given the vast amounts of knowledge and information given to me by everyone I met. Visiting New Zealand was a fantastic experience and I came away with lots of new ideas and information. It certainly has ignited my enthusiasm for farming in a more efficient and profitable manner.

Although we can't copy what they are doing due to different climate and management practices I am sure that there is a lot that Welsh farmers can learn to make their businesses more efficient and sustainable for the future. Kiwi farmers have to be efficient and maximise use of what grows naturally as they have no support system like we do and it's probably a timely reminder to those reading this that while we were getting between £70 and £90 a head for our lamb our kiwi counterparts are only getting the equivalent of about £35 a head. I have read a lot in the press recently about how we are going to cope with reduced subsidy and environmental payments under the Glastir scheme – well a lot of our destiny is on our own hands – we just need to look a bit harder at our businesses and adapt them to reduce our costs.

I am sure that we can adapt the principles of measuring and recording what pastures we grow and start managing our systems differently to utilise forage better. I remember one of the farmers telling me that one of the main advantages he sees of monitoring pasture growth is identifying fields that aren't performing that well and then trying to identify the problems with that field and rectifying it.

We budget our finances so why not budget for feed? Planning ahead is critical in any business and farming should be no different. Yes we do have winters where grass doesn't grow but we don't get any harder winters than some of the farms I visited. I am sure by applying some thought and careful management we could also extend our grazing season and save pasture from the autumn for feeding later in to the winter. Are we using the correct species of grass and forages? Maybe our favoured grasses are designed for our current system of winter housing with growth only really required in the spring and summer.

There is a growing demand for protein on worldwide scale and these needs are to be met at the same time as reducing emissions and wastage. But these goals are achievable - we just need to think a bit differently about how we manage our farms. If we put some thought and effort in to it I am sure we will be surprised by what we can achieve and produce lamb from a low cost base by fully capitalising what grows naturally. In my view the future of sustainable agriculture in the UK will rely on us grasping this concept.

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