Animal &
Grassland Research
and Innovation
Programme

Teagasc

National Sheep Conferences 2016

Shearwater Hotel,
Marina Point,
Ballinasloe, Co. Galway
Tuesday, 2nd February

Amber Springs Hotel,
Wexford Road,
Gorey, Co. Wexford
Thursday, 4th February

teagasc
Agriculture and Food Development Authority

Teagasc National Sheep Conference 2016 Programme

Venue: **The Shearwater Hotel, Ballinasloe, Co. Galway.**

Date: **Tuesday, 2nd February 2016.**

Conference Outline

Chairman *Professor Michael G. Diskin,* Teagasc, Athenry, Co. Galway.

17.00 **Conference Opening**
Tom Kellegher, Regional Manager, Roscommon / Longford, Teagasc.

17:10 What are the key, relevant take home messages for my farm?
Damien Costello, Teagasc.

17.20 – 17.50 Accelerating sheep genetic improvement
Dr. Norin McHugh, Teagasc.

17.50 – 18.20 The effect of stocking rate and prolificacy on profitability of a lowland sheep enterprise
Alan Bohan, Teagasc.

18.20 – 18.50 Clostridial and Pasteurella vaccination in sheep – Benefits and Pitfalls
William Fitzgerald, Regional Veterinary Laboratory, Limerick.

18:50-19:20 Setting up a profitable sheep farm – our experience
Ben Anthony and Diana Fairclough, Wales

19:20 **Close Conference**
Frank Hynes, Teagasc.

19:30 Tea/Coffee, Sandwiches & finger food served

Organising Committee:
Michael Diskin, Philip Creighton, Frank Hynes, Michael Gottstein & Ciaran Lynch.

Teagasc National Sheep Conference 2016 Programme

Venue: **The Amber Springs Hotel, Gorey, Co. Wexford.**

Date: **Thursday, 4th February 2016.**

Conference Outline

Chairman	*John Pettit, Acting Regional Manager, Wicklow / Carlow / Wexford Teagasc.*
17.00	**Conference Opening** *Professor Gerry Boyle, Director, Teagasc.*
17:10	What are the key, relevant take home messages for my farm? *Bob Sherriff, Teagasc.*
17.20 – 17.50	Accelerating sheep genetic improvement *Dr. Norin McHugh, Teagasc.*
17.50 – 18.20	The effect of stocking rate and prolificacy on profitability of a lowland sheep enterprise *Alan Bohan, Teagasc.*
18.20 – 18.50	Clostridial and Pasteurella vaccination in sheep – Benefits and Pitfalls *William Fitzgerald, Regional Veterinary Laboratory, Limerick.*
18:50-19:20	Setting up a profitable sheep farm – our experience *Ben Anthony & Diana Fairclough, Wales*
19:20	**Close Conference** *Dr Philip Creighton, Teagasc.*
19:30	Tea/Coffee, Sandwiches & finger food served

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Michael Diskin, Philip Creighton, Frank Hynes, Michael Gottstein & Ciaran Lynch.

Foreword

Sheep production is a significant contributor to the agricultural and national economy with an output valued at €243.1 million in 2015. This represents an increase of 5% on 2014 with volume of meat output having increased 2.3%. The 34,000 flocks produce a high quality product, with about 75-80% of this exported. Significant employment is provided in both the primary production and processing sectors. The improvement in lamb prices in recent years, combined with reduced feed costs, would all suggest that 2016 should be a good year for the sheep industry. However, there is no room for complacency. Technical performance in terms of ewe productivity, grassland management, stocking rate and flock health are all important drivers of profitability and must be the sustained focus of all sheep producers. This is the clear message from today's conference.

In the Teagasc 2014 National Farm Survey an average gross margin of €668/ha for lowland mid-season lambing flocks was achieved. However, the top one third of flocks generated a gross margin of €1,085/ha compared to €308 for the bottom one third of flocks. Ten per cent of sheep flocks generated a gross margin of >€1,000. However, only 33% of flocks reared >1.4 lambs/ewe put to the ram and only 29% of farms were stocked at >9 ewes /hectare. This indicates that there is significant scope to increase income by improving technical efficiency on many farms. This is also evident from the significant productivity and gross margin gains achieved on the Teagasc Research and Demonstration Flock in Athenry and on the Teagasc BETTER Sheep Farms. Modest improvements in a number of key technologies have very significant impacts on productivity and profitability. I would strongly encourage sheep producers and Discussion Groups to visit the Teagasc BETTER farms and to visit the Athenry flock. Active participation in such Discussion Groups has been shown to be a most effective way of getting new technology adopted on farms which subsequently translates into increased productivity and increased farm income.

I welcome the change in the format of this year's Sheep Conferences with the increased focus on relevant take home messages. Farmers should focus on implementing a number of the messages from today's conference. This is now the 4th year of the Teagasc National Sheep Conferences and they play a very important role in technology transfer to the sheep industry. This booklet collates and summarises a significant body of knowledge on technical issues in sheep production and should prove an invaluable reference to sheep producers. I would like to thank all the Teagasc Staff who assisted with the organisation of the National Sheep Conferences and especially the organising committee without whose efforts we would not be here today – they are; Michael Diskin, Frank Hynes, Phil Creighton, Ciaran Lynch and Michael Gottstein. I also acknowledge the help and input of local Teagasc advisory staff.

Director, Teagasc.

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Accelerating sheep genetic improvement in Ireland

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Take home messages

- Genetics indexes should be used as a selection tool when selecting rams and pay careful attention to:
  1. Selection traits of interest
  2. Accuracy of the indexes
  3. Star ratings of important traits for your production system
- Validation of existing commercial data shows that the genetic indexes are selecting for superior maternal and terminal traits
- The INZAC flock will assess the suitability of New Zealand genetics for Irish grass based systems
- Genomic selection will help to increase the accuracy of the genetic indexes

Introduction

Animal genetics is a powerful tool that allows farmers to select superior animals to become the parents of the next generation and has been shown to be directly responsible for over half the production gains achieved across livestock species. Genetics involves the passing of genes (favourable and unfavourable) from parents to offspring and unlike feeding or management it is permanent and cumulative. The national genetic indexes is crucial to enable farmers to make more informed breeding and selection decisions to ensure that they have the desirable combination of genetics for their flock. To date rapid increases in genetic gain have been achieved by the Irish dairy and beef industry, the rate of genetic progress in sheep has increased albeit at a slower than desired level. This paper will review the gains achieved to date and highlight future improvements that will accelerate genetic improvement for the national sheep population.

Current status

The Sheep Ireland €uro-star indexes were introduced in 2009 with the aim of providing sheep farmers with an additional tool for the selection of breeding animals. The genetic indexes aim to identify a low cost, easy care sheep with good maternal characteristics, but that also produces a good quality lamb that reaches slaughter at an early age. Each animal's index is calculated based on its individual animal performance (such as lambing information and weights) and the animal's relatives (i.e. sire and dam); currently this animal performance data feeds into Sheep Ireland from two main sources: commercial and pedigree data. Commercial farm data are collected on large numbers of commercial animals through the Teagasc BETTER farm programme and the Central Progeny Test (CPT). In the commercial flocks rams from different breeds are mated to a central group of diverse commercial ewes

and their progeny performance is recorded. Information on the progeny managed in a commercial environment feeds back into the genetic indexes of the pedigree rams used and also all his relatives. Currently data on over 5,000 commercial animals are included in the genetic evaluations on a yearly basis. Detailed animal performance information is also recorded by pedigree breeders through the LambPlus scheme, with the help of STAP the numbers of pedigree breeders recording information in the last number of years has increased dramatically and currently over 600 pedigree breeders are entering data on their pedigree animals for the national genetic evaluations. This has been reflected in an increase in the number of pedigree rams sold through sales with star rating information.

Sheep Value Indexes

The establishment of a genetic index involves two main steps, firstly a list of traits or animal characteristics that influence the selection of an animal must be identified, thereafter each trait is weighted based on its economic value (€/lambs born) to farm profitability. A star rating is also assigned to each trait that allows farmers to visualise the ranking of animals within their breed (1 star = bottom 20%; 5 stars = top 20% of the breed). The Sheep Value indexes provide a measure of the genetic ability of the animal's progeny to generate profit at farm level for a combination of traits. The Sheep Value breeding indexes are split into two indexes:

1. **Terminal index** - ranks animals based on their ability to produce live, fast growing terminal progeny with little lambing difficulty. This takes into account the progeny's growth rate, carcass characteristics, days to slaughter and also lamb survival and lambing difficulty.
2. **Replacement index** - ranks animals on the expected maternal performance such as milk yield, lamb survival and the ease of lambing, however it also includes some terminal traits to account for the efficiency at which animal's progeny are finished.

Table 1
Relative emphasis for the trait groups in the Terminal and Replacement indexes

Trait Group	Terminal	Replacement
Growth	40%	12%
Carcass	23%	7%
Maternal	0%	68%
Lambing	37%	13%

What to look for in the indexes?

Before selecting a breeding ram each farmer must determine the most suitable animal for their production system. For example, if farmers are interested in finishing all their lambs then they should focus on the terminal index. On the other hand, if a farmer is looking to retain replacements then they should focus on the replacement index. Irrespective of the type of animal that is needed, careful attention should be placed on the € uro-value, star rating and the accuracy associated with the index or trait of interest. The higher the accuracy the greater the information that is known about the animal and the greater the confidence we have that their index value will reflect their true performance potential and

thereby reduce the fluctuations in animal star ratings. The €uro-value is the predicted extra profit that will be generated for the animals progeny compared to an 'average' lamb. For example a ram with an €uro value of €1.15 is expected on average to produce progeny that will generate €1.15 more profit compared to their average contemporaries. Assuming that a ram produces 100 progeny per year and survives within a flock for 4 mating seasons this ram is expected to generate €460 more profit across his lifetime compared to the average ram.

Does genetics work?

There are many examples of genetics in action internationally, for sheep one of the countries that has witnessed rapid improvements in production due to genetics is New Zealand. The New Zealand sheep population has declined from 68 million in 1985 to 30 million in 2014, however during the same period kilograms of lamb sold per ewe rose from 9.76 kg to 16.83 kg resulting in little change in the overall lamb meat production, much of these production gains have been attributed to genetics. In addition over 90% of rams sold in New Zealand are now sold based on their genetic evaluations which have helped to accelerate the increase in genetic gain for the national population. The contribution of genetics to profitable farming can be witnessed first-hand in both the dairy and beef sectors in Ireland with the dairy and beef indexes used as the main selection criteria for the selection of breeding animals by many commercial farmers.

To increase Irish sheep farmer's confidence in the national genetic evaluations it is important to demonstrate the benefits of selecting rams with high star ratings. To quantify the relevance and accuracy of the Irish sheep genetic evaluations for improving key profit traits in the national sheep population, animal indexes were compared to their performance on farm.

To assess the usefulness of the genetic indexes in detecting differences in performance between animals live-weights, lambing and reproduction data for the last three years (2013 to 2015) was extracted from the Sheep Ireland database on 7,644 commercial lambs and sire and dam indexes were compared to the corresponding lamb performance on farm The results clearly show that animals from parents with five star ratings had greater performance compared to lambs from one star parents (Table 2). Progeny from five star parents had less lamb mortality and required less assistance at birth. Ewes with a high star rating for the replacement index were on average 4.18 kg lighter but had a greater number of lambs born (+0.13 lambs) compared to the one star ewes. Progeny from five star parents were also heavier at 40 day weighing and also at weaning compared to progeny from 1-star animals. These results indicate that selection of breeding animals for favourable maternal and terminal genetic attributes will result in favourable improvements in performance and profitability at farm level.

Future plans

Although a considerable amount of work has been undertaken in sheep genetics to date, similar to the Irish dairy and beef industry, research is always necessary to further demonstrate the importance of sound breeding decisions on profitability. Some of the new research initiatives that are currently underway are outlined below.

Table 2. **Mean on-farm performance of offspring of sires differing in star ratings for key performance traits.**

Index	Trait	1 star	5 star
Replacement Index	Lamb Mortality (%)	16.64%	9.60%
	Number of lambs born	1.68	1.81
	Ewe mature weight (kg)	73.40	69.22
Terminal Index	Lambing Difficulty (%)	34.4%	21.36%
	40 day weight (kg)	18.98	19.52
	Weaning weight (kg)	31.94	33.02

INZAC flock

Previous research has shown that the rate of genetic progress is almost three times higher in the New Zealand sheep industry compared to the Irish sheep industry. Although the New Zealand and Irish indexes are selecting animals for similar characteristics, a genetic comparison of New Zealand versus Irish elite ewes has not been undertaken in a common environment; therefore to date it is difficult to assess the compatibility of the New Zealand ewe to Irish grass based production systems. The INZAC flock was established in Teagasc Athenry to address this question; the flock consists of 180 ewes from two main breeds, Texel and Suffolk, representing the top genetic merit animals in the Irish and New Zealand maternal indexes. The objective of this flock is to allow for the benchmarking of elite Irish genetics compared to elite New Zealand genetics and to validate the Sheep Ireland replacement index. The flock will evaluate the performance potential of New Zealand and Irish for animal characteristics such as lamb growth rates, milk yields, ewe reproduction and lambing traits. The evaluation of the Irish versus the New Zealand ewe commenced at mating in autumn 2015 and ewes will lamb for the first time in March 2016. The trial is expected to run for at least four years and results from this study will allow Irish farmers to assess the suitability of New Zealand genetics for Irish sheep production systems.

OVIGEN – genomic selection for sheep

Genomic selection is a new technology that has gained large traction in the Irish dairy and beef industry over the last number of years and has the potential to rapidly increase the rates of genetic gain for the Irish sheep industry. Genomics is a process that looks directly at the genes or DNA of a ram rather than waiting for his transmitted genes to be expressed in his lambs. DNA remains the same for an animal across its lifetime and therefore the increase in accuracy from genomic selection can be achieved when the ram is still a lamb. Genomic selection was launched for Irish dairy cattle in 2009 and the resultant accuracy of genetic evaluations in dairy increased by 40%, the expected genetic gain may actually be greater in Irish sheep since the current accuracy levels are lower and therefore the potential scope for improvement is greater.

Teagasc, Sheep Ireland and UCD have recently been awarded a research grant, OVIGEN, by the Department of Agriculture, Food and the Marine with the goal of implementing genomic selection for the Irish sheep industry. As part of the OVIGEN project, funding is available to determine the DNA of up to 12,000 animals. A prerequisite for genotyping is accurate performance recording and therefore to date the breeds with sufficient data recorded through the Sheep Ireland system are targeted for genotyping, these breeds include: Texel, Suffolk, Charollais, Vendeen and Belclare. In addition to the genotyping of the major breeds, a subset of 40 animals have been genotyped representing the minority breeds with the goal of quantifying the degree of relationship between the other breeds and the 5 main breeds currently recording in Sheep Ireland. For hill breeders and commercial farmers, low-cost parentage options using the genotyping technology are also under investigation to allow such flocks to start performance recording, as parentage recording is currently the biggest barrier for these groups of farmers to overcome in order to performance record their flocks.

New traits

As part of the OVIGEN project over 12,000 animals will be assessed by Sheep Ireland technicians and this provided an opportunity for additional data to be generated on new and existing traits. The data that is currently being collected includes: weight, body condition score, incidence of mastitis, dag scores and lameness scores. Preliminary results from the OVIGEN data show that on average 10% of ewes and 17% of lambs scored showed some signs of lameness and approximately 2.5% of ewes had mastitis. In addition the heritability estimates for both lameness (0.10) and mastitis (0.07) are moderately heritable, thereby indicating that both traits are under genetic control and can be incorporated into the genetic indexes once research is complete. Research is also on-going into other key traits such as carcass data, lamb vigour scored at birth, ewe fertility and ewe longevity. Future research will continue to focus on evaluating state-of-the-art technologies and statistical methodology to identify “easy to implement tools” to predict traits of economic importance in breeding goals.

Conclusions

Sheep genetic evaluations are now an important tool that allow sheep farmers to make more informed breeding decisions and has the potential to increase profitability at farm level. Teagasc will continue to work closely with the industry to further enhance sheep breeding and ensure that the benefits are clearly seen at farm level.

The effect of stocking rate and prolificacy on profitability of a lowland sheep enterprise

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Take home messages

- Stocking rate and prolificacy along with grass growth are the key drivers of profit
- Increasing the number of lambs weaned per hectare reduces the cost of production per lamb and in turn increases profit
- Lamb price has the greatest effect on profit
- Increasing the number of lambs weaned per hectare without increasing grass growth is counter productive

Introduction

Stocking rate and ewe prolificacy have been described as the key drivers of sheep farm profitability in Ireland, details from the 2014 e-profit monitor show that the top third of lowland sheep farms are stocked at 9.6 ewes per hectare and weaning 1.54 lambs per ewe joined to the ram; whereas the average farms are stocked at 7.5 ewes per hectare and weaning 1.45 lambs per ewe joined. These differences are further reflected in the corresponding gross margins with the top third generating €850 per hectare compared to €439 per hectare on the average farm. Ireland's average stocking rate and weaning rate (9.5 lambs per hectare), are significantly lower than international estimates, with an average weaning rate of 18.3 lambs per hectare in the UK, an average of 9.8 in France and 12.7 in New Zealand. The objective of this study is to quantify the effect of stocking rate and prolificacy on farm productivity and profitability. Within this study we will focus on three stocking rate and prolificacy scenarios using the Teagasc Lamb Production Model (TLPM): the national average (7.5 ewes/ha weaning 1.3 lambs per ewe joined), a medium output level (10 ewes/ha weaning 1.5 lambs per ewe joined) and a high output level (12 ewes/ha weaning 1.8 lambs per ewe joined).

Teagasc Lamb Production Model (TLPM)

The Teagasc lamb production model (TLPM) is a computer representation of a sheep farm that calculates the physical and financial outputs of a sheep system and allows the user to vary certain inputs such as stocking rate and prolificacy to assess their effect on farm productivity and profitability. The TLPM was built in Excel using real Irish farm data from the BETTER farms programme, Athenry research data, previous sheep research and input from industry experts. The model uses inputs such as animal numbers and valuations, farm size, scanning rate and lambing date to calculate the physical outputs such as: flock feed demand, mortality and culling rates, lamb growth rates and drafting patterns, numbers of

lambs sold, fertiliser and concentrate use, as well as, the financial outputs such as gross margin, return on investment and net profit. Data from the Research Demonstration flock in Teagasc Athenry was used to populate the main inputs for the TLPM such as lamb growth rates.

Scenario analysis

To quantify the effect of stocking rate and prolificacy the TLPM modelled a 20 hectare lowland sheep farm with a mean lambing date in early March. The modelled farm operated a grass based system with the majority of lambs sold off grass. Concentrates were only supplemented to ewes pre-lambing and to lambs that were not drafted by October. Within this modelled farm three stocking rate and prolificacy scenarios were analysed: 7.5 ewes/ha weaning 1.3 lambs per ewe joined (Low), 10 ewes/ha weaning 1.5 lambs per ewe joined (Medium) and 12 ewes/ha weaning 1.8 lambs per ewe joined (High). All scenarios had the same farm area and general farm management: stocking rate and prolificacy were the only inputs that were varied with the farm. The greater stocking rate and number of lambs weaned were accounted for by growing and utilising more grass and a slight increase in concentrate supplementation.

Physical results

The physical characteristics from the three modelled scenarios are outlined in Table 1. The three stocking rate and prolificacy levels resulted in flock sizes of 150, 200 and 240 ewes for the low, medium and high output flocks, respectively. The low output flock weaned 195 lambs (9.5 lambs/ha), the medium flock weaned 300 lambs (15 lambs/ha) and the high output flock weaned 432 lambs (22 lambs/ha).

Table 1. Physical characteristics of the three modelled farm scenarios.

	Low	Medium	High
Farm size (ha)	20	20	20
Stocking rate (ewes/ha)	7.5	10	12
Weaning rate (lambs/ewe joined)	1.3	1.5	1.8
Ewes joined to the ram	150	200	240
Lambs weaned	195	300	432
Lambs weaned/ha	9.5	15	22
Lambs sold/ha	8	13	19

Lamb mortality had a large effect on the number of lambs weaned; lamb mortality increased with prolificacy due to, among other things, greater lambing difficulty and lower lamb birth weight associated with greater proportions of multiple births. The total lamb mortality for the low, medium and high output farms was 11.84%, 13.44% and 15.54%, respectively. For the first two months lamb growth rates were driven by ewe milk yield and, thereafter, by the grass supply and quality. At lower prolificacys there is more milk and grass available per lamb, as well as, a lower worm burden challenge at grass, these factors resulted in greater lamb growth rates, pre and post-weaning, and greater weaning weights (Table 2). The high output flock had the lowest weaning weight at 31kg with a pre-weaning growth rate of 264 grams per day and a post-weaning growth rate of 166 grams per day (Table 2).

Drafting pattern was dependent on lamb growth rates. The ideal live weight for slaughter varied by target carcass weight and predicted kill out percentage, increasing from 40.5 kg in June to 47.5 kg in December. The drafting pattern for the three scenarios are shown in Figure 1 with the low scenario drafting 85.4% off grass, the medium scenario drafting 81% off grass and the high output farm drafted 71% off grass alone.

Table 2. Lamb pre and post-weaning growth rates and weaning weight for each of the three scenarios.

	Low	Medium	High
ADG pre-weaning (g/day)	299	275	264
ADG post-weaning (g/day)	190	181	166
Weaning weight (kg)	36.12	33.1	31.4

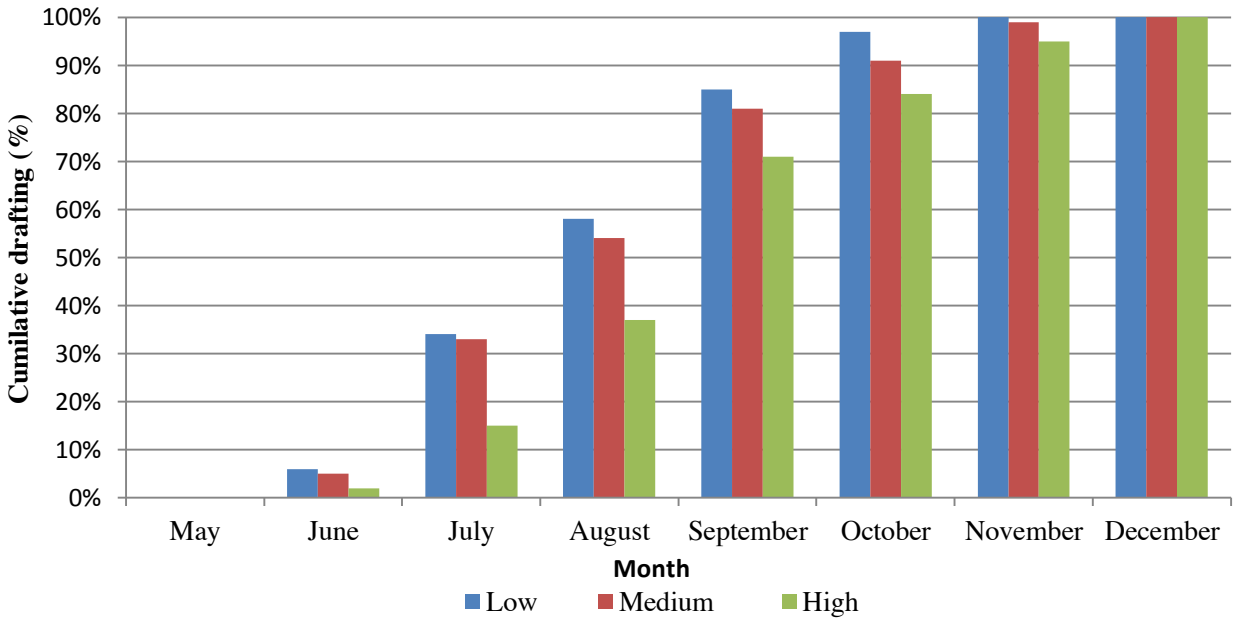


Figure 1. Cumulative drafting pattern by month of the low, medium and high output farms.

Similar to lambs weaned per hectare, the number of lambs sold per hectare is an important parameter to assess the productivity and profitability of a sheep enterprise. The number of lambs sold per hectare, the average carcass weight and the kilogram of carcass sold per hectare are outlined in Table 3. The low output farm sold 8 lambs per hectare, which resulted in a total of 167 kg of carcass sold per hectare. The medium scenario sold an additional 5 lambs per hectare resulting in a sale of 255 kg of carcass sold per hectare. The high output farm sold a total of 19 lambs per hectare which gave it a total of 364 kg of carcass sold per hectare, 197 kg (117%) more than the low output farm.

Table 3. Number of lambs sold per hectare, average carcass weights and kilograms of carcass sold per hectare for each of the three scenarios.

	Low	Medium	High
Lambs sold/ha	8	13	19
Average carcass weight	20.03	19.67	19.39
Kg of carcass/ha	167	255	364

Replacement costs can have a large effect on overall profit due to the cost of retaining or purchasing replacements. The replacement rate was calculated based on ewe culling and mortality levels in each of the scenarios, ewes were culled for barrenness or health issues such as mastitis. The replacement rates for the low, medium and high output farms were 18%, 19% and 22%, respectively. The high output flock had a slightly higher barren rate (5%) compared to the low and medium (4%) flocks which led to a greater culling rate in the (14.7%) compare to the low and medium flocks (12.5%). The higher stocking and weaning rates also had a knock-on effect on the overall ewe mortality rates in the medium and high output flocks, with a mortality rate of 5.5%, 6.5% and 7.3% recorded for the low, medium and high flocks, respectively.

System performance

As flock size and prolificacy increase more feed is required for the additional animals, in the scenarios modelled the additional feed comes in the form of grazed grass. The farm systems with medium and high levels of output need to grow and utilise greater amounts of grass while keeping fertiliser and concentrate levels relatively low. The low output farm grew 7,305 kg/ha of grass, the medium output farm grew 9,771 kg/ha and the high output farm grew 12,471 kg/ha. As grass growth increased, greater fertiliser was required, the low, medium and high farms spread 75 kg/ha (60 units/ac), 115kg/ha (92 units/ac) and 150 kg/ha (120 units/ac) of nitrogen, respectively.

After fertiliser, the next biggest contributor to the variable costs was concentrate costs and so it is crucial that concentrate use is kept to a minimum. Ewes received 21 kg/ewe, 23 kg/ewe and 26 kg/ewe for the low, medium and high producing farms, respectively. The vast majority of lambs were finished off grass; lambs that were not drafted by October were supplemented with 400g of concentrates per day at pasture from October onwards. As stocking rate increased that number of lambs that weren't drafted by October increased which resulted in an increase in the amount of concentrate fed to lambs. On average lambs received 1.3 kg/lamb, 2.4 kg/lamb and 4.3 kg/lamb for the low, medium and high output farms, respectively.

Financial results

Farm profit is governed by income and costs. The low output farm sold 8 lambs per hectare equating to €785/ha, whereas the medium output farm sold 13 lambs/ha which equated to €1,200/ha. The high output farm highlighted the importance of number of lambs weaned per hectare as the farm generated €1,695/ha in lamb sales by selling 19 lambs per hectare. The total farm income also included cull and wool sales, despite this lamb sales still accounted

for 88%, 89% and 90% of total farm income in the low, medium and high flocks, respectively. Variable costs have a large effect on the overall profit of the farm. The variable costs are the costs that the farmer has greatest control over and, apart from lamb price, will be a key determinant of farm profitability. The largest contributors to the total variable costs are fertiliser, concentrates and veterinary costs. As the flock size and lamb crop increases more grass is required for the additional animals and in turn the fertiliser costs increased from €148/ha in the low system to €215 in the medium system and to €269 in the high output system. A similar trend was noted in the concentrate cost with higher prolificacy resulting in greater concentrate supplementation to the ewes pre-lambing; in addition the lower lamb growth rates resulted in a greater number of lambs left in October that were finished off grass and concentrates. The total concentrate costs were €6.72, €7.87 and €10 per ewe for the low, medium and high flocks, respectively. The gross margin is calculated by subtracting the variable costs from the gross output. The low, medium and high output farms had gross margins per hectare of €316, €575 and €915, respectively.

Fixed costs are the costs not directly related to the level of output, they include electricity, insurance and buildings and machinery depreciation. The fixed costs were relatively similar across all three farms but were slightly higher in the high (€253/ha) compared to the medium (€243/ha) and low (€230/ha) output flocks due mainly to a greater infrastructure depreciation associated with the larger flock.

Net profit is calculated as the total income less total costs (including the interest on loan repayment and bank overdraft). After all the costs of production the net profit was calculated as €45/ha for the low, €285/ha for the medium and €610/ha for the high output flocks. The net profit figures do not include labour costs or any direct payments.

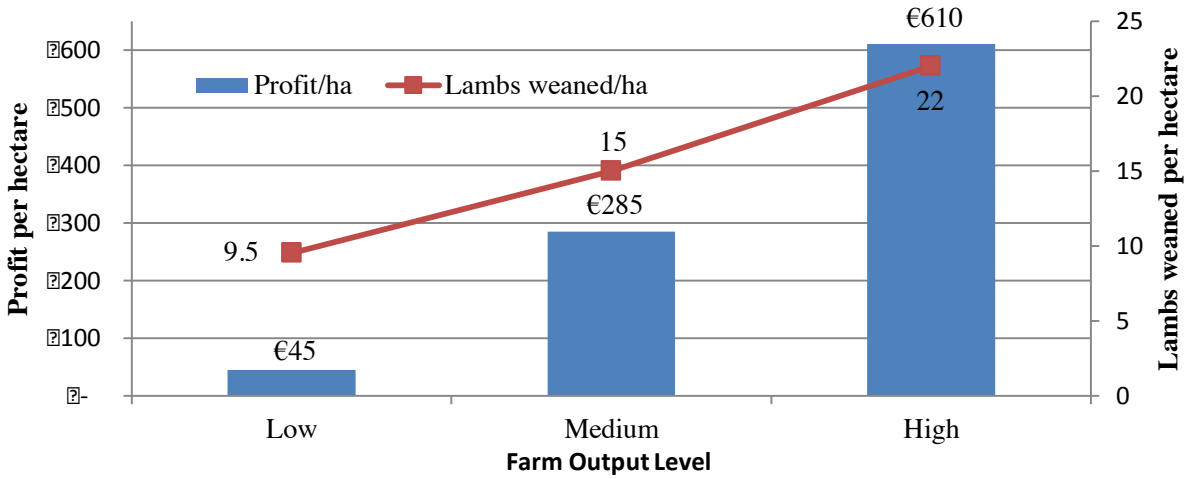


Figure 2. The effect of lambs weaned per hectare on profit.

Table 4. **A summary of the profit and loss account for each farm scenario presented in euros per hectare (€/ha).**

€/ha	Low	Medium	High
Income			
Wool sales	37	49	60
Lamb sales	785	1,200	1,695
Cull sales	69	97	128
Total farm income	891	1,346	1,883
Variable costs			
Concentrates	50	79	120
Straw	33	44	54
Fertilizer	148	215	269
Reseeding	25	33	42
Livestock purchases	17	22	27
Silage making	46	62	76
Vet & medicine	105	149	197
Machinery operation & repair	94	94	94
Other variable costs	57	73	89
Total variable costs	575	772	968
Gross margin	251	575	915
Fixed costs			
Farm vehicle	82	82	82
Electricity & Phone	24	31	37
Farm insurance	43	43	43
Infrastructure depreciation	33	38	42
Machinery depreciation	49	49	49
Total fixed costs	230	243	253
Farm net profit	45	285	610

Sensitivity analysis

To determine the effect of variation in lamb price (±10%), concentrate price (±10%), fertiliser price (±10%) and lamb mortality (±3%), on farm net profit sensitivity analysis was undertaken within the TLPM. Across all three scenarios varying lamb price by 10% had the greatest impact on net profit and resulted in a fluctuation in net profit by 175%, 42% and 27% for the low, medium and high output flocks, respectively. Fertiliser had the second greatest effect on profit in the low and medium farms at 34% and 7.5% change, respectively, and the third largest effect in the high output farm changing profit by 4%. Lamb mortality was the second most important variable for the high output farm causing a 7 to 7.5% change in profit. Concentrate price had the least effect on profit in all three scenarios.

Sensitivity analysis was also carried out to assess the effect maintaining grass growth would have on profit. When stocking rate and prolificacy was increased grass growth was maintained at the low output level and the surplus feed requirements were matched with bought in concentrate. When the medium output scenario maintained grass growth at 7,305 kg/ha but increased the number of lambs weaned to 15 per hectare, the net profit per hectare fell from €285 to -€153. Similarly, when the high output farm increased lambs weaned per hectare but maintained grass growth at 7,305 kg/ha the net profit per hectare fell from €610 to -€368.

Cost of production

The cost of producing a lamb or one kilogram of carcass varies with the number of lambs weaned per hectare; at the low output level the cost of producing one kilogram of lamb was €5.07 or €102 per lamb carcass. At a medium level of output the cost of producing a kilogram of lamb reduces to €4.16 or €82per lamb carcass, finally at the high level of output the cost to produce one kilogram of lamb reduces to €3.50 and €68per lamb carcass. The lower cost of production is due to the greater efficiency associated with the ewes in the higher output system, as well as, the dilution effect of the cost of production across the additional lambs. The higher output farms grew and utilised more grass and in turn were able to increase the number of lambs sold per hectare. Table 5outlines the total farm income, total costs and net profit per lamb sold for the three farm scenarios.

Table 5. Carcass value, total income per lamb sold, total costs per lamb sold and net profit per lamb sold for each of the three scenarios.

	Low	Medium	High
Average Carcass value (€)	94	92	90
Average total income/lamb sold (€)*	107	104	100
Average total costs/lamb sold (€)	102	82	68
Average net profit/lamb sold (€)	5	22	32

*Including cull, wool and carcass sales.

Conclusions

The productivity and profitability of three sheep farms scenarios was assessed using the Teagasc Lamb Production Model. The simulation of the three farm scenarios analysed the physical and financial of each system. Previous research suggested that stocking rate and ewe prolificacy were the key drivers of profit on Irish sheep farms. The simulation of the three different farm output levels showed that the amount of grass grown and utilised along with stocking rate and ewe prolificacy are the key driver of profit. The extra grass grown allowed for the greater number of lambs weaned per hectare with an increase from 15 lambs/ha to 22 lambs/ha (47% increase) increasing net profit by €325/ha (114% increase). Increasing the number of lambs weaned per hectare without increasing grass growth and utilisation resulted in a negative net profit figure.

The cost of production has a large effect on the profit per lamb. The lower output farms have a higher cost of production per lamb and in turn a lower profit per lamb. This highlights that increasing the number of lambs weaned per hectare not only increases the amount of produce for sale but also the profit per unit of produce. Future uses of the TLPM include research into additional farm system changes to assess their impact on profitability, it will also be used to calculate economic breeding values to aid in the genetic evaluations of the Irish sheep flock, as well as, providing a means of adding an economic component to other systems research.

Vaccination against Clostridia and Pasteurella - the Benefits and Pitfalls

William FitzGerald,
Limerick Regional Veterinary Laboratory, Knockalisheen, Limerick.

Take home messages

1. Administer the full vaccine course to lambs at the recommended intervals
2. Store the vaccine correctly
3. Use clean, sterile needles for vaccination and maintain high levels of cleanliness throughout the work
4. Use a vaccine which covers as many Clostridia as is available. If you wish to use a vaccine with Clostridial and Pasteurella elements, remember that there are less Clostridia covered in the combined vaccine

Introduction

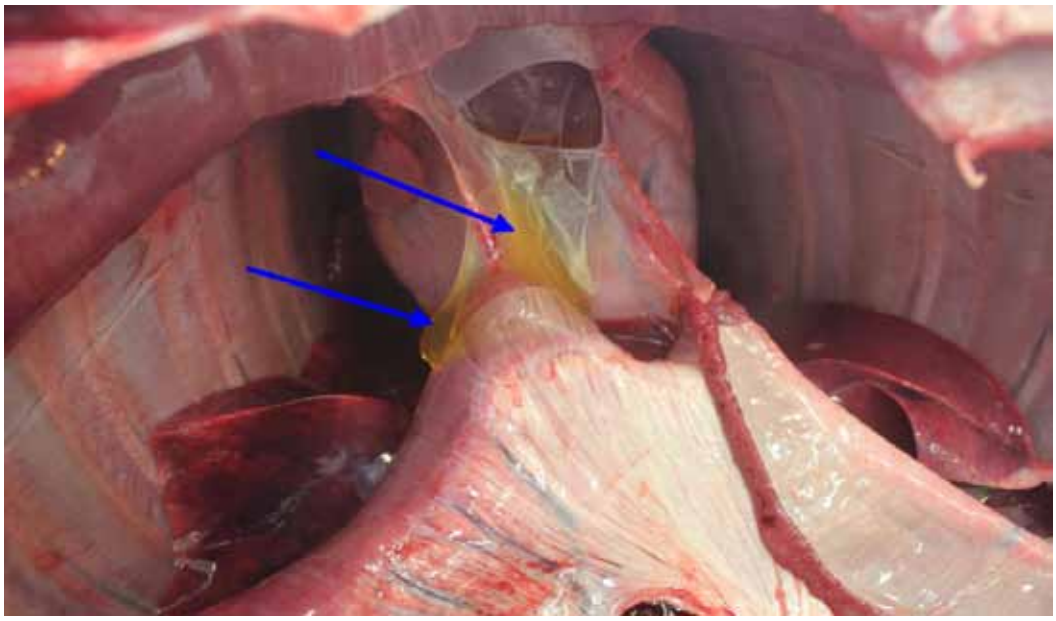
Clostridia and Pasteurella are two families of bacteria that can cause major problems for sheep flocks in Ireland. Clostridia are ubiquitous bacteria, which means they are essentially everywhere. They are found in the soil and in the intestinal tracts of animals and people. They are anaerobic bacteria, meaning that they cannot multiply in the presence of air. When they are exposed to air, they form tiny airtight capsules called spores which allow them to survive until they are back in an environment without air. These spores are extremely durable and can easily survive for extended periods in the environment. Clostridia cause a number of diseases in sheep, the majority of which are fatal. Most of these diseases do not cause detectable illness other than sheep found dead and outbreaks of these diseases are not uncommon. Table 1 lists the most common diseases that are caused by Clostridia that are encountered in Ireland.

Table 1. A list of the common Clostridia and the diseases they cause in sheep

Clostridium Species	Disease
Clostridium chauvoei	Metritis in Sheep
Clostridium septicum	Malignant oedema and Braxy (sheep)
Clostridium novyi type A	Big head of rams
Clostridium novyi type B	Black Disease
Clostridium sordellii	Gas gangrene and Abomasitis
Clostridium perfringens Type B	Lamb dysentery
Clostridium perfringens Type C	Struck (Not in Ireland)
Clostridium perfringens Type D	Pulpy kidney

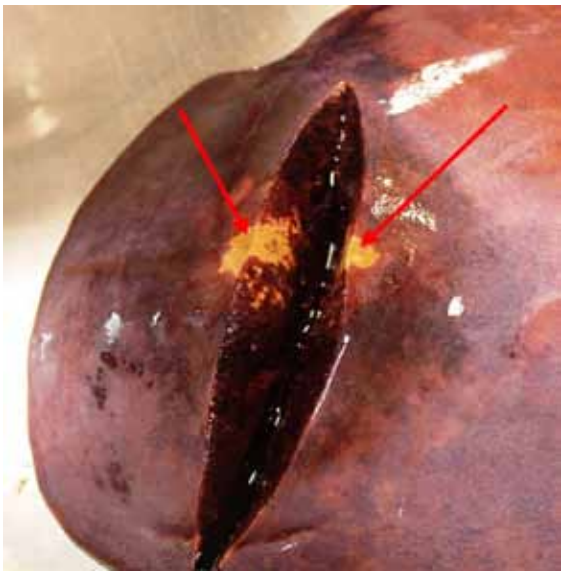
Pulpy Kidney Disease (aka Clostridial Entertoxaemia) is the most common clostridial disease diagnosed in the veterinary laboratory service (both in the Republic of Ireland and Northern Ireland) in sheep. It is commonly identified in fast-growing lambs, typically over one month of age that are consuming high concentrate diets, or sucking heavy milking

ewes. Losses in a flock often coincide with a sudden change in feed or increase in the plane of nutrition. There have also been a number of cases of Clostridial enterotoxaemia in adult sheep though a specific case of the condition known as struck has not been identified yet in Ireland. Photograph 1 shows the clot (blue arrows) seen around the heart in cases of Clostridia enterotoxaemia.



Photograph 1. *Photograph showing the clot (highlighted by blue arrows) seen around the heart of a sheep with clostridial enterotoxaemia (courtesy C. O'Muireagain, Sligo RVL).*

Black Disease is also common disease in Ireland. It occurs in tandem with liver fluke infestation. The bacteria are picked up from the soil, multiply in damaged areas of the liver killed off by migration of immature liver flukes and produce a powerful toxin which results in death of the sheep. Photograph 2 shows the necrotic (dead tissue) areas of the liver (red arrows) which are infected by Clostridia in a case of Black disease.



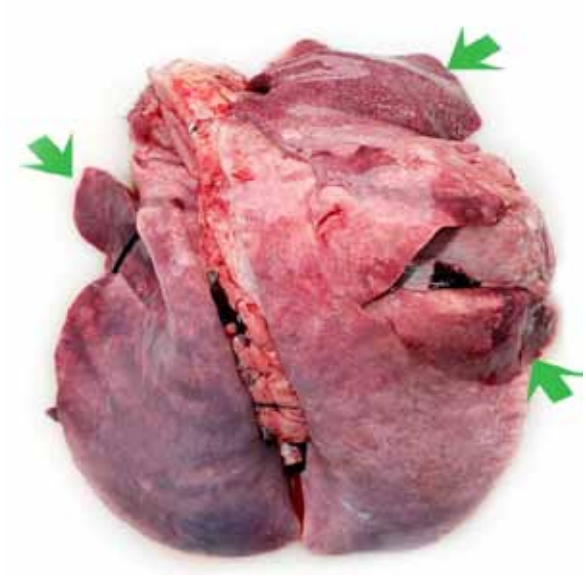
Photograph 2. *Photograph showing the liver of an animal that died of Black disease*

Braxy ***(Photograph 3)*** and Abomasitis (infection of the stomach) are essentially the same disease, caused by two different strains of clostridia and in slightly different ways. Braxy (aka Frosty grass) tends to occur in either adult or yearling sheep. It tends to occur in the winter and early spring when there is a ground frost. The animals eat the frozen grass which damages the lining of the stomach allowing the clostridia to infect the damaged tissue. More recently, abomasitis has been described in young lambs from three to ten weeks of age and in finishing lambs of 6 to 12 months of age. The process by which the bacteria are able to infect the stomach wall is not completely understood.

Photograph 3. *Photograph showing the folds of the stomach which have turned blackish in colour as a result of being frozen by frosty grass and subsequently infected by clostridia (courtesy C. O'Muireagain, SRVL)*

Other diseases including metritis (infection of the womb), big head of rams, malignant oedema and lamb dysentery also occur but are not commonly encountered in the laboratory service.

Pasteurellosis or septicaemic pasteurellosis (blood poisoning) usually begins as an infection in the airways or lungs (Photograph 4). The bacteria that cause this condition are commonly found in the tonsils and throat of healthy sheep. In the event of encountering stressors (heat, overcrowding, exposure to inclement weather, poor ventilation, handling, or transportation) these bacteria replicate and invade the lungs. In some cases, these bacteria will have replicated to such an extent that they can enter the blood stream and release their toxin, causing septicaemia. It is believed that some viruses like PI3 and RSV can also be instrumental in allowing these bacteria to multiply and infect the lungs. Typically, this entire process occurs within a short time frame (hours to days at the most). As a result, many of these animals are found dead. Those that do present clinically are usually very ill and the success rate following treatment is low.



Photograph 4. *Photograph showing the congested areas (highlighted by green arrows) of the lungs of a sheep that died as a result of Pasteurellosis (courtesy of C. Sanchez-Miguel, CRVL)*

Vaccination remains the most effective way to control both Clostridial and Pasteurella disease within Irish flocks. The recommended vaccination regime is shown in Table 2.

Table 2. A typical vaccination schedule for both Clostridial and Pasteurella vaccination in sheep.

Ewe	4-6 weeks prior to lambing to boost antibody levels in the ewes colostrum
Lambs	1st shot@ 3 weeks of age (some vaccines can be given as early as 2 weeks)
	Booster shot 4-6 weeks after initial shot – Very Important
	Boost 12 months later – annual booster

It is important to vaccinate the ewes in relation to these diseases as their colostrum is the main source of antibodies against these diseases in the newborn lamb. By annually vaccinating the ewes, their antibody levels remain sufficiently high to allow protective cover to be transferred to the lamb. However, it must also be remembered that in order for these lambs to benefit from the vaccination, they must receive adequate quantities of good quality colostrum within the first 2 hours after birth. The sooner the lamb gets this colostrum, the more benefit they will get from it.

Benefits of vaccination

Likelihood of clostridial diseases and sheep deaths are drastically reduced.

Disadvantages of vaccination

- Handling – potentially a stress on heavily pregnant ewes.
- Cost – Relatively small in comparison to losses due to disease
- Risk of introducing or transmitting infections like Caseous Lymphadenitis (CLA)

The most common pitfalls with vaccination

1. Not giving lambs the full primary course. By not completing the vaccination course, the immunity levels from the first vaccine shot are not sufficient to protect your sheep and you can still have losses. This is a very common theme heard across the RVLs from farmers submitting sheep and cattle for post mortem.
2. Administering a lower dose of vaccine than is recommended. By administering a smaller vaccine dose, the sheep is being under dosed and as a result will have a lower antibody response which may well not be protective in the face of infection.
3. Incorrect storage of the vaccine. Vaccines must be kept refrigerated as per the instructions and are sensitive to temperature changes.
4. Not using a vaccine which covers multiple Clostridia. There are a number of vaccines on the Irish market, many of which cover up to 10 individual Clostridial bacterial species and toxins. It is advisable to use a vaccine that covers as many Clostridia and toxins as possible as the difference can be catastrophic and in many cases the prices difference between the two vaccines per sheep is small.
5. Good technique and cleanliness

Setting Up a Profitable Sheep Enterprise, Our Story

Diana Fairclough and Ben Anthony
Frowen Farm, Carmarthenshire, Wales.

Key take home messages

- It all starts with the soil which grows the forage to feed the animals
- Look at Ewe nutrition the whole picture
- Infrastructure work smarter not harder
- Record & monitor your performance and aim to improve on it

Don't be afraid of change, keep moving your business forward

Above: Ben & Diana in a Red Clover Ley

Farm History

We, Ben Anthony & Diana Fairclough, farm 145 acres (58.7 hectares) which includes 35 acres of woodland at Frowen farm which is situated in Carmarthenshire approximately 5 miles from Whitland in South West Wales. We took over the farming business from Diana's parents in 2010 which was primarily a suckler cow unit. We have been fortunate to rent an additional 90 acres adjoining the family farm and a further 20 acres approximately 5 miles away. Since 2010 sheep numbers have increased from approximately 300 ewes to currently just over 570 ewes and a further 160 ewe lambs, whilst the suckler cows have reduced from 40 cows plus young stock to 17 cows, plus 25 store cattle at present. Our system at Frowen is a forage-based system as Ben is very keen on his grassland management with approximately 30 acres a year being ploughed and reseeded with leys containing high sugar grasses and red clover, with brassicas used as a break crop.

Our main passion is with the sheep enterprise and over recent years we have changed the farming practices which had become the tradition at Frowen. Historically, we used to sell fat lambs on the live market and breed our own replacement ewe lambs. We made the decision to concentrate our efforts on the fat lamb market as we felt trying to do both was conflicting and we almost needed two separate flocks. We now buy in all our replacement ewe lambs from one source to minimise the risk of disease. The flock was historically made up of Texel cross and Suffolk cross ewes but we decided we wanted a lighter, more prolific ewe capable of increasing lamb output. Over the last 3 years we have been purchasing Aberfield cross improved Welsh ewe lambs and feel that these best suit our system. The Aberfield is a superior composite derived from a nucleus flock that has been developed over the past 10 years using the top performing Bluefaced Leicester rams from sire recorded flocks and crossed with specific Texel Lines. Aberfields have been bred by Innovis and are one of their maternal lines. Aberfield rams are bred on a forage based system.

Above left: *Aberfield Rams,* ***Above Right:*** *Aberfield X Tregaron Welsh Yearling Ewes.*

These rams have then been used on Tregaron Welsh ewes and these are the ewe lambs we have been purchasing. The Aberfield is a robust ewe which are easy to manage, lighter than our traditional ewes, easy lambing, and good mothers capable of rearing twins which are fast growing, meaty lambs, off a forage-based system. As we now concentrate on fat lamb production and we only use performance recorded terminal sires, such as Abermax (composite breed from the best Texel and Charollais genetics) and Primera (composite meat sire developed by Focus Genetics NZ and are available in the UK exclusively through Innovis).

We lamb all our ewes indoors in two bunches due to shed space constraints. Historically, we started lambing at the end of January and it lasted until the beginning of May. In 2014, we changed the lambing period to start at the beginning of March and end at the end of April. This has been shortened through the use of teaser rams. Although lambing just over a month later we have still sold new season lambs in 2014 & 2015 at the end of May which is the same time as previous years. The main influential reasons for this change in lambing period is that we now have more grass available for the ewes and lambs at turn out and even if we have to feed out we are much closer to the grass growing season. When we took over the farm it was not set up for intense sheep system which we envisaged and aimed to have. At times it seemed like an uphill struggle not knowing which way to turn. The fields were all in permanent pastures with a low PH status ranging from 4.9 to 5.5. The fencing infrastructure was not suited to sheep and the frustrations of the ewes and lambs moving themselves around the farm was annoying and disheartening to say the least. In the spring of 2013 all our neighbours had our telephone number on speed dial as the sheep moved themselves to their land as the grass was always greener on the other side of the farm boundaries. Although we tried hard with electric fences it has been an uphill battle which we are slowly winning.

Where we are now?

The infrastructure of the farm was our main aim and at times it was difficult to know what to do first. We needed to fence our stock in but we also needed to improve the pastures to improve lamb performance with the aim as any business, to increase profit. We also realised that the sheep enterprise had to change as we were trying to produce fat lambs and retain ewe lambs from the same flock, we needed a single focus. We made the decision to concentrate on fat lamb production and to buy in replacement ewe lambs. All our decisions involved investing heavily in the business and we realised that this was going to be a long and slow process. Over the past three years through taking advantage of whatever schemes were available, we have managed to fence the complete boundary of the farm and quietly

we are now working on internal fences. We have pushed ourselves to improve the pasture and over the past four years we have spread 530 ton of lime and the PH status has improved to between 5.8 and 6.5. We plough and re-seed some pasture each year and plant root crops such as swedes and fodder beet to fed ewes pre-lambing. These not only provide plenty of fodder but also act as a break crop for the pasture. The ultimate aim with the flock is to have an Aberfield X ewe flock and we estimate we are approximately half way to achieving this as we have been purchasing Aberfield X ewe lambs since 2012.

We became a demonstration farm for Farming Connect in July 2013 which was an honour. Our hard work and effort to progress the farm was recognised and this then opened doors for us to be able to work closely with some of the country's top consultants. We have been working with Lesley Stubbings (sheep consultant) who could see what we were trying to achieve with our flock. We actually sat down and went through our records to see where we could make improvements. We were open to all new ideas and suggestions and were willing to try anything to improve the flock performance. Scanning % has increased from 150% in 2011 to 195% in 2016. Lamb losses from scanning to turn out have been reduced from 16.7% in 2012 to 3.9% in 2015. This is mainly due to improved ewe nutrition and dealing with a enzootic abortion problem through introducing a vaccination programme. See below table for the comparison of flock performance.

Table 1. Details of scanning % and lamb losses from 2011 to 2016.

Year	Scanning %	Losses % from Scanning to Turn Out
2011	150	7.4
2012	165	16.7
2013	156	22.3
2014	170	5.1
2015	189	3.9
2016	195	-

The cattle numbers on the farm have been reduced. The three main reason for this is that we are in a TB area and it was always a concern that if we had TB we would be unable to sell our calves as stores in the spring and would, therefore, be chasing grass and forage all summer. Furthermore, we would not have enough shed space to house the suckler cows, their calves and the previous year's store cattle. Secondly, the existing cattle housing needs replacing and we could not justify the investment in the cattle housing as well as the sheep and other infrastructure of the farm. The third reason, as mentioned earlier, we are both passionate about the sheep although we would not be without any cattle as we use them as a management tool alongside the sheep, but sheep are where our interests lie.

What we have changed?

We have been using teaser rams since 2013. This has had several benefits to our flock performance. It has tightened the lambing period which in turn allows us to target labour for busy periods. The lambs are more uniformed at worming and weaning etc. As our lambing period has been condensed we are now able feed the in lamb ewes to ensure they are receiving what they need when they need it, which has contributed towards reduced feed costs.

The feeding regime has had a total overhaul. We have always analysed our silage but now we match the cake requirements with our forage availability. Last year (2015) we fed a

21% protein cake which was made especially for us, although this works out at a higher cost per ton, we were feeding a lot less, twin bearing ewes had a phased introduction from approximately 6 weeks prior to lambing building up to 350 grams for the three weeks prior to lambing alongside a 50% mixture of grass and red clover silage. Prior to matching the cake to the silage we would feed a good quality 18% cake and twin bearing ewes were having just under a kilo. With these changes we have reduced the tonnage of cake we use by approximately 50%, also remember that our scanning % has increased. This year (2016) after analysing our silage, we are aiming to reduce the feed costs further and have selected a 34% protein cake. The twin bearing ewes will have a phased introduction of the cake building up to 250grams for the final three week prior to lambing.

Since the introduction of EID to the flock in 2013, we now record all lambs at birth and look closely at our flock, both the ewes and rams to monitor performance. We now base our decisions on facts and figures. Any poor performing ewes or troublesome ewes are identified and are culled out at weaning. Historically, we used to wean remaining lambs at anything between 16 and 18 weeks of age. For the last two years we have weaned at between 12 and 13 weeks of age. Although we were nervous at first we have seen that the lambs perform better post weaning with improved Daily Live Weigh Gains (DLWG). Early weaning has several benefits we can manage and better utilise our grass. The lambs have all the best grass whilst the ewes follow round behind them, this also helps to reduce the worm burden. Weaning early also gives the ewes extra time to gain condition for the next tupping period, which we believe has been a contributing factor to an increase in our scanning %. Any cull ewes can be sold reducing the pressure on the grass situation. At this point we condition score all our ewes and again target their feeding regime accordingly, poorer ewes get better grass.

Another tool which we have been using for the past two years is the FECPAK Generation 2 system developed by Techion Group Ltd, New Zealand. This system is used for Faecal Egg Counting (FEC). Since using this we have established that we do have wormer resistance but through carrying out different tests we now know which groups of wormers do and don't work for us at Frowen. This saves us spending valuable money and time using products which no longer work for us. Regular faecal egg counts in conjunction with existing farm management practices such as weighing and stock observation allow us to make more accurate drench decisions. We weigh all our lambs at 8 weeks of age so that we can monitor their DLWG, in 2015. From birth to 8 weeks they grew between 340-350 grams per day. Lambs are then weighed on a regular basis until they leave the farm. We find it useful to weigh the lambs regularly and monitor their DLWG to aid decision making. We can also establish how fast or slow they are performing on different crops. Once the lambs reach 36kg live weight we separate them out and they then graze a red clover ley for finishing. All lambs are now sold deadweight and the slaughter reports provide valuable information to aid monitoring the flock. In 2015 the average live weight of the lambs going to slaughter was 40.92kg and the average deadweight was 19.96kg giving an average killing out rate of 48%.

Forage has been a big part of what we have changed since we started working with Charlie Morgan (grass land consultant, Grassmaster Ltd). We have been working on ploughing the whole farm in a rotation to improve grassland performance. We now grow root crops to feed ewes over the winter period. We have grown swedes for the last four years which are grazed in situ. This also adds organic matter to the soil and allows the grass fields to be rested and

Left: *Grazing Swedes, Twins from one direction and Triplets from another* ***Above:*** *Aberfield Ewe Lambs.*

Above left: *Primera Ram.*

Above right: *Abermax Rams. Both used as terminal sires*

ready for ewes and lambs to be turned out on. This year we have experimented further and have grown fodder beet. The in-lamb ewes are currently grazing this in situ and it appears to be working well. After the brassica crops we reseed with high quality grass leys which include high sugar grasses or finishing crops for lambs as part of our crop rotation examples of these would be red clover, chicory and a plantain mix.

Our Plan for the next 3 – 5 years

- Complete Infrastructure work – have all internal fields fenced which will aid rotational grazing, and install more water troughs in the larger fields.
- Invest in the sheep buildings – the current lambing shed is dilapidated and out-dated. We have invested in the land, flock and the infrastructure and now feel with the current flock performance we can justify investment in a purpose built lambing shed.
- Establish an all Aberfield X Tregaron Welsh ewe flock rather than a mixture of different breeds. This is currently ongoing as the older ewes are culled out.
- Keep monitoring developments in Genetics in order to continue to improve flock efficiency.
- Keep investing in grassland and forage crops to maximise lamb performance and production
- Grass measuring – utilise our grass more efficiently to maximise output. Make greater use of rotational grazing. This is becoming easier with the improvements to the farm infrastructure, but we still have some work which needs to be carried out to assist with the logistics of this to enable us to get the most out of the farm.
- Improve autumn lamb performance. We are pleased with the early growth rates of the lambs but need to concentrate on finishing the last of the lambs sooner to allow us to concentrate on the ewes pre-tupping.
- Lamb all ewes in one group in March – This relies heavily on the ability to invest in a new lambing shed as currently we lamb in two groups due to lack of shed space.
- Use EID more to highlight the bottom 10% of our ewes and cull them.
- Be open to any new ideas such as farm diversification. We are looking into the possibility of setting up a Wigwam site to bring another source of income into the farm, which would allow Diana to work full time from the farm as currently she works part-time off farm.

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