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CONTENTS

Dairy farming stocked at 170kg organic nitrogen/ha (2 cows/ha) – a farmers perspective

Pat Clancy
Dangan House, Ballyporeen, Co Tipperary

Objective

The objective of this paper is to examine the implications of the 'Nitrate Directive' on a dairy farm stocked at 170kg organic nitrogen/ha. The farm is situated outside Ballyporeen, Co Tipperary, and comprises a total of 51.8 ha (50 ha adjusted) milking 60 cows to fill 71,543 gallons in spring milk production. The farm supplies to Dairygold, and has been in REPS (Rural Environment Protection Scheme) for the past 3 years.

The herd traditionally comprised mostly black and white Holstein Friesian cows, but in the last number of years the breeding policy has switched to mostly high EBI, New Zealand sires (see Table 1). No stock bull is used.

Table 1. Bulls used in 2005 and 2006

2005	RUU, UYC and LWK
2006	HZO, KLA, UYC and LWK

Average yield per cow is approximately 1250 gallons at 3.45% protein and 3.90% fat. The farm is stocked at 1.6 LU/ha. Due to drought conditions in 2006, 650kg of meal per cow was fed, but more typically this figure is 450kg/cow.

Until recently the majority of the bull calves were kept until weanling stage and sold out of the shed in the spring. However, in 2007, most of the bulls were sold as calves at three weeks of age. All heifer calves are kept. There are also a number of Norwegian Red crossbreds and purebred replacements on the farm as part of a Moorepark 'on farm' trial testing these animals. The Teagasc Profit Monitor for the farm in 2005 indicated Common Profit of 14.94 c/litre and Common Costs of 15.17 c/litre. No figures are available for 2006.

Winter housing arrangements

Cubicle accommodation is available for 65 cows. Prior to calving the cows are grouped on a calving date basis, and those near calving are fed late in the day. A further 30 cows are housed in older cubicles and slatted area e.g. cull cows and any late calvers. A separate shed with smaller cubicles and a scraper system has the capacity to deal with 40 weanlings. These have access to an easy feed area for silage and meals.

Slurry storage capacity is sufficient to comply with the 'Nitrate Directive'. It will be necessary to modify the existing yard to cater for soiled water. The milking parlour is a 10-unit herringbone with 3 foot centres.

Grass silage forms the mainstay of the winter diet. A total of 46 acres are closed for first cut silage, and any additional surpluses removed via round bale silage (approximately = 6.5 acres in bales).

What happens when cows calve?

The aim on the farm is to get cows out to grass directly after calving. Fresh calvers are out from February 1 by day and full time by March 1 depending on grass growth. They are fed on 4-5kg of meal and some grass silage by night. Grass silage is removed from the diet as soon as grass supply improves.

Grass growth is measured weekly in order to calculate farm cover during the early and main grazing season. This facilitates assessment of growth rate relative to demand, and all decisions based on this. Approximately 8-9 acres are reseeded annually because old paddocks are slow to grow grass in the spring.

Stock numbers and organic nitrogen and phosphorus calculations

The current position is as shown in Table 2.

Table 2. Organic nitrogen and phosphorus production

	No.	Organic Nitrogen per cow (kg)	Total Organic nitrogen (kg/ha)	P per cow (kg)	Total Phosphorus (kg)
Dairy cows	60	85	5100	13	780
In calf heifers	18	57	1026	8	144
Weanlings	17	24	408	3	51
Stock bull	0	65			
Total			**6534**		**977**

Dividing these total figures by net area (50ha), total Organic N/ha = 130kg/ha. In REPS a further 130kg of bag nitrogen is permitted, bringing the total nitrogen level to 260kg/ha. There is a further 2 years left in REPS 3, which must be completed. As the farm is under the 170 kg organic nitrogen limit, no derogation will be required.

Fertiliser programme

Slurry

Most of the slurry goes out on the silage ground after cutting. This reduces the requirement for bag nitrogen considerably. Two of the smaller tanks are emptied in January and February.

Fertiliser

Under the new Nitrate regulations, if stocked at 130kg organic nitrogen/ha, the farm is in the same bracket as farmers under 170 kg/ha. This would allow for the spreading of 226kg/ha of available nitrogen, equating to 214kg of bag fertiliser or 171 units/acre that is 6.3 bags CAN/acre. With adherence to the nitrogen limits set down in REPS 3, the maximum amount that may be applied over the whole farm is 3.85 bags of CAN/acre. The strategy followed is to apply 0.5 bags of urea on reseeded pasture (silage ground and some paddocks) in mid February. Another 0.5 bags of urea on grazing ground in early April, followed by a 0.5 bags CAN after each grazing. A final blanket application of 0.75 bags of CAN is applied in mid/late AUGUST. One round of fertiliser is skipped in July when the whole farm is available for grazing.

Table 3. Fertiliser spread in 2006

Pasture Sward	CAN	Urea
0 tonnes	11 tonnes	8 tonnes

The farm was soil sampled at the start of REPS and is in P Index >3. This limits Phosphorus application levels to a total of 314kg of Phosphorus. In REPS, this equates to spreading 4 ton of 0-7-30.

Table 4. Fertiliser plan for 2007

Pasture Sward	CAN	Urea
0 tonnes	11 tonnes	8 tonnes

Implications of new rules for the business

- **Stocking rate** – As the farm is under the 170kg limit, there is no need for an organic nitrogen derogation. By selling bull calves at 4 weeks of age allows the farm to stay below the 170kg limit.
- **Fertiliser** – The new rules will not reduce the amount of bag nitrogen that can be spread.
- **Slurry storage** – There is adequate storage for the 16 week closed period. Some minor changes will have to be made so that soiled water/slurry from the milking parlour can be catered for.
- **Closed periods** – In REPS you are required to finish spreading bag fertiliser by August 31. This means the new rules should not be more restrictive. In a normal year, no nitrogen is spread before mid February.

Dairy farming at 250 kg organic N/ha (2.9 cows/ha)

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Introduction

The objective of this paper is to illustrate the basics of the new Nitrates Directive as it impacts on a typical dairy farm. The farm in question comprises a total of 25.4 hectares (62.7 acres), with 47 adjusted acres on the home block and 12.5 acres at a distance of 2 miles. In the 2006/07 production year, 50 cows produced approximately 70,000 gallons in spring milk production (1,490 gallons/acre). The intention for 2010 is to produce 70 to 75,000 gallons in spring milk production.

The land base is restricted for several reasons:

- Coilte has a coniferous forest, which bounds the farm on one side;
- The Bandon area is a hugely intensive area for dairying and demand for land both to buy and rent is very high - €200/acre annual rent is common;
- The wealth of the construction industry is driving land price out of agricultural reach, e.g. asking price for a 27 acre block of land = + €1 million (€37,000/acre).

Cows are black and white Holstein-Friesian. AI has been used extensively in the last number of years, e.g., in 2005 – RUU, PGZ, LOO, BCG and ERC: 2006; ERC, DXA, LOO and NWF. A Friesian stock bull is used to mop up.

In 2006 the first year in spring milk, production yield averaged 1,450 gallons/cow at 3.30% protein (217 kg protein) and 3.88% fat (256 kg fat), a total of 472 kg of milk solids per cow. A total of 900 kg of meal per cow was fed in 2006.

For the last number of years most of the bull calves were kept until 16 to 18 months of age and finished as bulls for slaughter. In 2007 all bull calves were sold at three weeks of age due to the increase in stocking rate.

Winter housing arrangements

There is cubicle accommodation for 66 cows, with a separate shed for in calf heifers and weanlings. Slurry storage capacity complies with the Nitrates Directive. The milking parlour (built in 1995) is a low line, 5-unit double up with 2 foot 6 inch centres.

Grass silage forms the mainstay of the winter diet. First cut silage is taken from the 12.5 acre block away from the main farm, with surplus paddocks removed as they arise (in 2006 approximately 9 acres was conserved from the home farm, with a further 15 acres of first and second cut grass silage purchased).

What happens when cows calve?

Prior to switching to spring calving, the aim was to get cows out to grass as soon as there was significant grass growth. Typically winter milkers went out from February 20 to March 15, depending on grass growth. For the future the plan is to get cows out even earlier as the herd is now spring calving only. Great care must be taken to avoid poaching paddocks. A stand off pad is used if ground conditions are poor. Due to the high stocking rates, it has not been possible to reseed paddocks, but continuous grazing keeps swards in good condition. Strip grazing is used to ensure paddocks are well grazed down.

Stock numbers and organic nitrogen and phosphorus calculations

Current position is as follows:

Table 1. Organic Nitrogen and Phosphorus

	No	Organic Nitrogen per cow (kg)	Total Organic Nitrogen (kg/ha)	P per cow (kg)	Total Phosphorus (kg)
Dairy cows	55	85	4675	13	715
In calf heifers	18	57	1026	8	144
Weanlings	36	24	864	3	108
Stock bull	1	65	65	10	10
Total			**6630**		**977**

Divide these total figures by net area (adjusted) = 25.45 (SFP application), organic nitrogen/ha = 261 kg/ha.

This means there is a requirement to;

(a) Reduce stock numbers, or;
(b) Increase land base – even with an 'Organic Nitrogen derogation' he farm is still too heavily stocked.

For 2007 the intention is to reduce weanling numbers to bring the farm under the 250 kg limit – see Table 2.

Table 2. Organic nitrogen and phosphorus used in 2007

	No	**Organic Nitrogen per cow (kg)**	**Total Organic Nitrogen (kg/ha)**	**P per cow (kg)**	**Total Phosphorus (kg)**
Dairy cows	55	85	4675	13	715
In calf heifers	18	57	1026	8	144
Weanlings	23	24	552	3	69
Stock bull	1	65	65	10	10
Total			**6318**		**938**

Dividing total figures by net area (adjusted) = 25.45 (SFP application), organic nitrogen/ha = 248 kg/ha. By reducing weanlings from 36 to 23 brings the farm under 250 kg organic nitrogen/ha and within 'Derogation territory'.

Inputting these stock figures into the Teagasc Fertiliser Programme, the farm is allowed spread:

- 4 tonnes of Urea (1.27 bags urea/acre)
- 17 tonnes of CAN (7.4 bags CAN/acre) – can all be applied as CAN if so desired.

The total P and K figures are 0.7 t of 0:10:20 (14 bags in total), or 1.1 t of 0:7:30 (22 bags in total).

Fertiliser programme 'Old' and 'New'

Slurry – There is good use of slurry in the front half of the season. It is very valuable and replaces bag nitrogen in the system. Better results are got earlier rather than spreading after first cut silage. Approximately 80% of the slurry is spread by April 1, and slurry is spread from mid January on the paddocks that will be last in the first rotation.

Bag fertiliser – 0.75 bags of urea is spread in late January on paddocks that get slurry. On those that don't receive any slurry they get 1.5 bags of pasture sward. During the main grazing season the grazing rotation usually goes from 25 to 28 days, with one bag of CAN spread after each grazing.

Table 3. Fertiliser applied in 2006

Pasture Sward	CAN	Urea
5 t	10 t	4 t

The land is assumed a P index of 3 where no soil samples are taken. This limits phosphorus application to a total of 250 kg over the whole farm.

Table 4. Possible fertiliser plan for 2007

Pasture Sward	CAN	Urea
3 t	14 t	4 t

Implications of the new rules for the business

- **Reduce stock** – To get within 'Nitrogen Derogation levels' weanling numbers will have to be reduced to bring the business under the 250 kg limit.
- **Increase area farmed** – As already outlined this is a difficult option.

- **Bag fertiliser rules** – Considering the quantities previously spread, it should be possible to stay within the targets set out in the new 'Nitrate rules'. If more silage was grown as opposed to purchased, then the limits would be in danger of being breeched.
- **Closed spreading periods** – In general the closed periods will not restrict the potential of the farming system (slurry can be spread from January 12, whilst all spreading of bag fertiliser has to be completer by September 15).
- **Scaling up** – It will be necessary to apply for the Organic Nitrogen Derogation to 250 kg/ha. If the option to increase cow numbers is pursued, it will have to be via contract rearing of heifers to reduce stock numbers further on the farm. Another option is to increase milk yield per cow by introducing more feed, but this requires careful consideration.

Conclusions

The biggest challenge will be to produce milk efficiently on the 'home farm' and stay within the stocking rate rules laid out in the Nitrates directive. In general the fertiliser rules or closed periods are not considered detrimental to future progress.

Profitable dairy farming at 2.0 and 2.7 cows per hectare

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Introduction

The present EU dairy market regime combines price support, through measures like intervention buying, import tariffs and export subsidies, with milk quotas to limit production levels. The 2003 reform of CAP agreed to retain the present milk quota system until April 1, 2015, however, it is expected that the quota issue will form an important part of the 2008 review of CAP. The EU Commission's wish to phase out milk quotas coincides with a desire to have a lower milk price in order to cope with lower import tariffs and end export refunds, to avoid possible pressure for compensation for loss of quota assets, avoid pressure from new member states for additional quota and pressure from free-market member states (the London group) to end milk quotas. It is clear from this that the Irish dairy farming sector is facing challenges and continued technical innovation based on increased performance from grazed grass is very important for the sustainability of Irish dairy farming in the long term.

One of the major competitive advantages that Ireland has over most EU countries is the potential production of between 12 to 16t DM/hectare over a long growing season from pasture. This is most efficiently converted into milk when grazed *in-situ*. It is envisaged that the cost of both concentrate feed and grass silage will continue to increase over the coming years – in the former due to increased world demand and lower supplies, and the latter due to increases in contractor charges associated with inflation in labour, energy and machinery costs. In recent years grazing management strategies have been identified that increase the proportion of grazed grass and reduce the dependency on grass silage in Irish systems of milk production.

The Nitrate Directive was introduced with the aims to protect water quality against pollution from agricultural sources, with a primary emphasis on better management of livestock manure and other organic fertilizer. The Nitrate Directive set a legal limit of 170kg of organic nitrogen that can be applied per hectare (a stocking rate of 2 LU/ha). A derogation has been obtained that will allow dairy farmers increase stocking rate up to 250kg of organic N/ha. This is important as a 170kg limit of organic nitrogen across all dairy farms would erode the competitiveness of the grass based system in Ireland relative to other higher input systems in the EU.

This paper discusses optimum present day and futuristic grass-based systems of milk production, taking into account new environmental and possible future EU policy changes.

Productivity of Irish grassland

Land use and soils

The total land area in Ireland is 6.9 million hectares of which 4.3 million hectares is used for agriculture and 0.7 million hectares for forestry purposes. Ninety percent of agricultural land is devoted to grass and 10% to arable agriculture. Dry lowland mineral soils account for about 62% of the agricultural area, while moderately wet mineral soils account for 20%, and wet impermeable mineral soils for around 17% (Coulter et al., 1996). Some 50% of the land area of the country is generally classified as good agricultural land.

Table 1 shows the proportion of grassland area by farming type and corresponding fertiliser usage. Of the total arable and grassland area 36% is farmed under the Rural Environment Protection Scheme (REPS), 47% is farmed extensively, 7% is farmed intensively and the remaining 10% is used for arable agriculture. REPS is a scheme designed to reward farmers for carrying out their activities in an environmentally friendly manner and to bring about environmental improvement on farms. The objectives of the scheme are (i) to establish farming practices and production methods that reflect the increasing concern for conservation, landscape protection, and wider environmental problems. In return for payments this scheme requires compliance with environmental conditions that limit nitrogen from organic fertiliser to 170kg/ha/year and total nitrogen input to a maximum of 260kg/ha/year, (ii) to protect wildlife habitats and endangered species of flora and fauna and (iii) to produce quality food in an extensive and environmentally friendly manner. Currently there are 49,500 farmers participating in the scheme, 75% of which is financed by the EU and the remaining 25% by the Irish exchequer. It is projected that the number of farmers participating in REPS will increase from 49,500 (August 2006) to 55,000 by the end of the year.

Table 1. Chemical fertiliser nitrogen and phosphorus on arable and grassland by farm types

Farming-type	Proportion of Land-area (%)	Chemical Fertiliser use (kg/ha)	
		Nitrogen	Phosphorous
REPS	36	66	6
Extensive	47	76	8
Intensive	7	200	13
Arable	10	149	31

Source: Connolly *et al.*, (2004) and Coulter *et al.*, (2005).
Average chemical fertiliser nitrogen use on grassland = 82 kg/ha
Average chemical fertiliser phosphorus use on grassland = 7.6 kg/ha

Productivity of Irish grassland

Very high levels of grass dry matter (DM) production are possible under Irish conditions. The potential productivity can be assessed from ryegrass cultivar evaluations carried out by the Department of Agriculture and Food (DAFF) at five widely distributed locations around Ireland. Under ideal conditions, the production capacity of newly sown perennial ryegrass is approximately 17.6 tDM/ha/annum

(Table 2). This compares favourably with the dry matter production of forage maize (uncovered - 12.8 tDM/ha) under Irish conditions.

Table 2. Annual production of maize and cultivated ryegrasses in crop production evaluations at five stations distributed around Ireland (average of four years; grass harvested on six occasions per year) (DAF, 2004; DAF 2005)

	Annual production (tDM/ha)	
Crop	2004	2005
Forage Maize (uncovered)	12.2	13.4
Forage Maize (under plastic)	N/A*	17.0
Early perennial ryegrass	18.5	18.2
Intermediate perennial ryegrass	17.8	16.7
Late perennial ryegrass	18.0	16.8
Italian ryegrass	21.1	20.9

*No data available

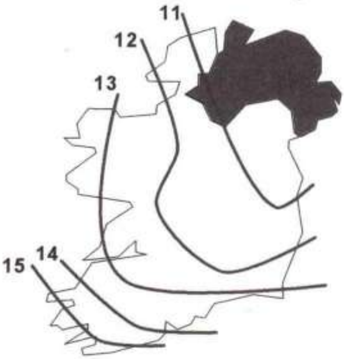
However, while these data provide an indication of potential grassland productivity, they are not representative of typical grassland in Ireland. The productivity of grassland is being assessed on an on-going basis at various Teagasc (Agriculture and Food Development Authority) research stations (Table 3). Permanent grassland swards are harvested under simulated grazing using methodology outlined by Corral and Fenlon (1978). The productivity of grassland has been reasonably consistent at between 13.6 and 15.8 tDM/ha (averaging 14.5 t/ha) across a range of sites spanning the length and breadth of the country.

Table 3. The productivity of permanent grassland under simulated grazing around Ireland (Teagasc (Agriculture and Food Development Authority): Various Research Reports)

Site	Measurement years (N)	(t DM/ha/yr)	SD
Moorepark	20	14.5	1.2
Kilmaley	13	14.2	1.8
Solohead	8	15.8	1.9
Ballyhaise	6	14.4	1.5
Grange	7	13.6	1.0
Average		**14.5**	

Brereton (1995) using a modelling approach estimated that the productivity of grassland ranged from 11 tDM/ha in the northern parts of Ireland to 15 tDM/ha in the southwest based on a chemical N input of 250kg/ha (Figure 1). Brereton, Danielov and Scott (1996), in a modelling exercise, estimated the total annual grass dry matter production for Western Europe to be up to 2 tonnes of DM less than in Ireland.

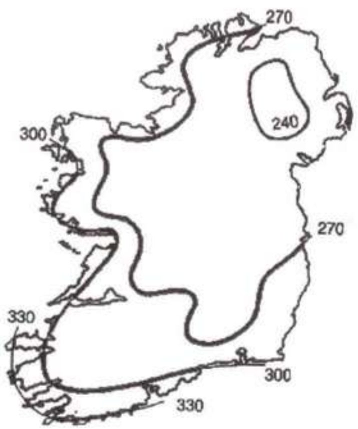
Figure 1: Grassland yield in Ireland (Brereton, 1995)



Length of grass growing season

Generally, air or soil temperatures determine the beginning and end of the grass-growing season. Broad and Hough (1993), considered the beginning of the growing season to be delineated by an air temperature of 5 to 5.5°C and the end of the growing season by an air temperature of 8°C. Hence, grass growth continues virtually all year round in the south west of Ireland and for around 250 days in inland areas of the northeast (Figure 2).

Figure 2. Average length of the grass-growing season in Ireland (Brereton, 1995)



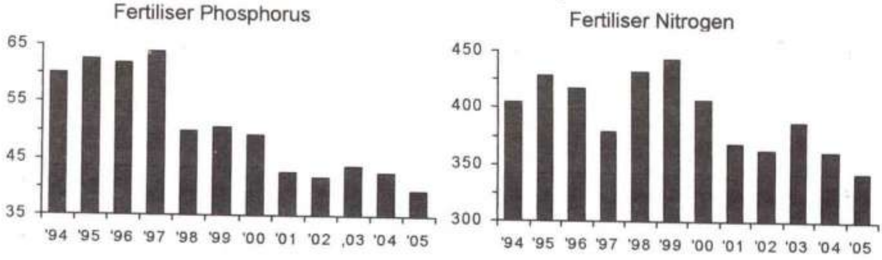
Brereton *et al.*, (1995) estimated that mean grass growth rates over a 150-day winter period (November 1 to March 31) varied from 5kg DM/ha/d in northern parts of Ireland to 11kg DM/ha/d along the south-west coast of Ireland. Brereton and McGilloway (1999), recorded average grass growth rates of 5.0kg DM/ha/d at Moorepark between November 1 and March 21, (140 days). Also at Moorepark, O'Donovan *et al.*, (2004) recorded average daily grass growth rates of 13.5kg DM/ha between October 20 and March 18 (159 days) over three years. Hennessy (2004) recorded average growth rates of 6.1kg DM/ha/d at Grange in the Northeast and 11.9 kg DM/ha/d at Moorepark between October 10 and February 20 (133 days) over two winter periods. Therefore, in general, grass growth rates in Ireland will range between 5 and 12kg DM/ha/d during the winter period depending on location. Assuming a winter period extending from November 1 to March 1 (120 days), grass accumulation during this period is between 600 and 1400kg DM/ha.

Trends in chemical fertiliser use in Ireland

The average chemical fertiliser nitrogen use on grassland in Ireland is 82kg/ha/year. Data from the National Farm Survey 2000 (Connolly *et al.*, 2001) indicate that average stocking rates on dairy farms in Ireland are just less than 2 livestock units per hectare. Average annual fertiliser nitrogen use on such dairy farms was recorded as 176kg/ha, while annual fertiliser phosphorus use was recorded as 12kg/ha. There was an upward trend in annual fertiliser nitrogen use in Ireland during the 1990's (Figure 3). This coincided to some extent with the increases in livestock numbers during this period. However, since peaking at over 440,000 t/year during 1999, annual fertiliser nitrogen use declined to 363,000 t in 2004 and declined further to 352,000 t in 2005.

Annual fertiliser phosphorus use in Ireland was approximately 60,000 t of elemental phosphorus between 1991 and 1997 and then fell sharply to around 50,000 t between 1998 and 2000, before declining to its 2004 level of under 43,000 t and declined further to 38,600 tonnes in 2005 (Figure 3). The decline in national fertiliser phosphorus usage since 1997 is partly due to a campaign by Teagasc which commenced in 1996, to increase awareness among farmers and bring fertiliser phosphorus inputs more in line with requirements. It also coincided to a certain extent with a substantial number of farmers joining the REPS.

Figure 3. Chemical fertiliser phosphorus and nitrogen use in Ireland between October 1993 and September 2005 ('000t/year)



<u>Nitrogen and phosphorus loading from livestock manure in Ireland</u>

Using Irish National Farm Survey data from 2002, the number and type of farms that currently exceed an output of 170kg nitrogen per hectare from livestock manure can be identified (Table 4). By applying the nitrogen production per head figures (Table 4) to animal numbers on survey farms, levels of nitrogen per hectare from livestock manure of utilised agricultural area can be estimated. This provides an insight into the number of farmers currently exceeding the limit as a result of the number of grazing livestock maintained on the holding.

Table 4. Number of farms currently producing more than 170kg of nitrogen/ha from livestock manure

System	No. of farms	Percentage	Avg. (kg N/ha)
Dairy specialist*	5,641	30	201
Dairy and other	2,518	20	205
Cattle rearing	597	2	179
Cattle finishing	744	3	189
Sheep	434	2	181
Mainly tillage	-	-	-
Total	9,934	9	199

*Dairy specialist farms are those with over 66% of the standard gross margin from the dairy enterprise (National Farm Survey data 2002).

Approximately 30% of specialist dairy farms and 20% of mixed dairy farms currently exceed the 170kg limit compared to 9% across all systems. Almost 33% of the Irish national milk quota is produced on farms that are currently producing more than 170kg of nitrogen per hectare from livestock manure.

The above estimate of the number of holdings exceeding the 170 kg nitrogen limit has been confirmed by a preliminary analysis of Irelands Cattle Movement Monitoring System (CMMS database 2005).

Competitive factors in relation to grassland systems in Ireland

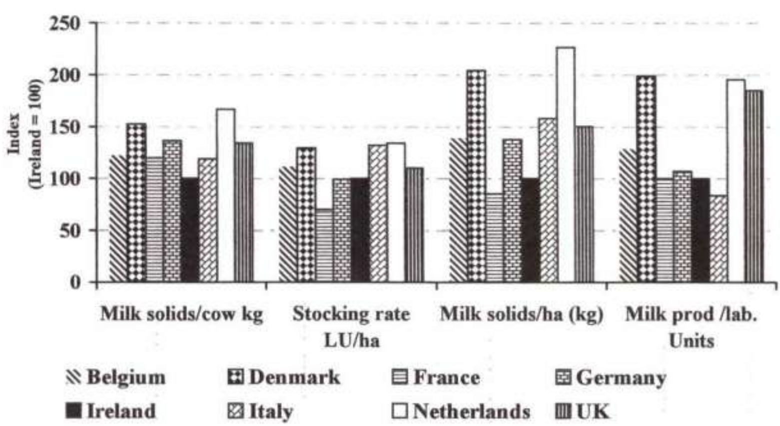
Competitiveness

The relative competitiveness (using partial indicators) of Irish specialist milk producers *vis-a-via* those in Belgium, Denmark, France, Germany, Italy, and the Netherlands using data from the European Commission's Farm Accountancy Data Network (FADN) (Thorne and Fingleton, 2005) was measured in relation to milk production, stocking rate and labour productivities. The measures were:

- Milk solids per cow (kg)
- Stocking rate (livestock units/ha)
- Milk solids (kg of fat plus protein) per hectare
- Milk production per labour unit (tonne).

Figure 4 shows that the average milk solids per cow were lowest in Ireland. The results presented for each of the countries is the average for the years 1996 to 2003 and indexed relative to Ireland. In particular, milk solids per cow in the Netherlands and Denmark were 66% and 52% higher, respectively, than in Ireland. Similarly stocking rates in Ireland were low; with only France and Germany having stocking densities equivalent or lower than Ireland. Stocking rates in the Netherlands and Denmark were 34% and 30% higher than in Ireland.

Figure 4. Productivity measures for selected EU countries (1996- 2003)



The combination of the generally lower stocking densities and lower milk solids per cow for Ireland, result in Ireland having the lowest milk solids per hectare compared with all other countries with the exception of France. The Netherlands and Denmark again produced well in excess of the other countries examined, with milk solids production per hectare 200 per cent higher than Ireland. The final partial productivity measure – milk production per labour unit was again highest in the Netherlands and Denmark, with levels in the UK also relatively high. Italy was the only country that exhibited lower labour productivity than Ireland, but average levels in France and Germany were very similar to Ireland.

The results for the individual years between 1996 and 2003 exhibited a significant trend over time for three of the six partial productivity indicators, namely: milk solids per cow, stocking rate per hectare and milk solids per hectare. Of these indicators, milk solids per cow for Irish dairy farms increased significantly by on average 0.012 kg per cow per year relative to the average of all countries. In contrast, stocking rate (cows per hectare) and milk solids per hectare decreased relative to the average of all countries examined, by on average 0.01 cows per hectare and 0.09kg of milk solids per hectare respectively, over the time period examined.

Farming system

Using 2004 National Farm Survey data (Connolly *et al.*, 2004), and nitrogen production figures per head of animal (S.I. 378, DAF 2006), Table 5 shows the number and percentage of specialist dairy farms operating at different rates of organic N per hectare.

Table 5. Number of specialist dairy farms at various rates of organic N per hectare

	< 170 kg REPS	<170kg Non-REPS	170kg-230kg	>230 kg N/Ha	Full Sample
Number of Farms	3800	9,897	4,301	397	18,395
Farms (%)	21	54	23	2	

Source: Irish National Farm Survey Data (2004)

Table 6 Shows farm performance Indicators at various rates of organic N per hectare. The results show that on average farms participating in the REPS scheme were 43 hectares compared to an average of all specialist dairy farms of 51 hectares. Those operating at less than 170kg per hectare but not in the REPS scheme are larger than average. This may suggest that as farm size increases the attractiveness of REPS declines because of the capped level of payment. Farms in the REPS scheme tend to have smaller than average total livestock units, while farms intensively stocked, i.e. 170kg per hectare or greater, tend to have larger than average livestock numbers. The differences in milk quota sizes are large and statistically significant, with farmers in REPS having the smallest quota size and those operating at 170kg per hectare and greater having the largest. The average REPS payment for farms in the scheme was €6,250.

Table 6. Farm performance Indicators at various organic N per hectare rates

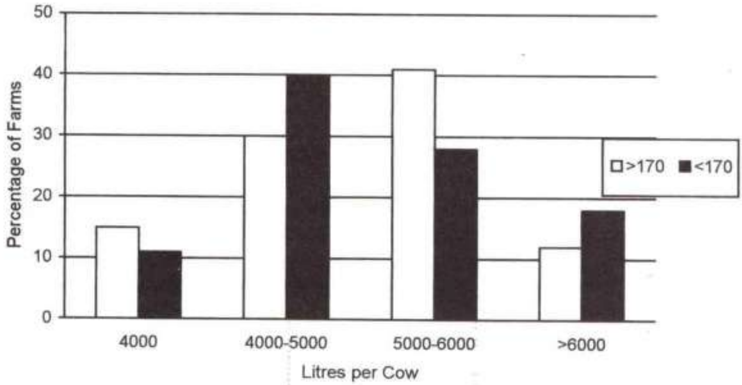
Indicators	< 170 kg REPS	< 170 kg Non-REPS	>170 N/Ha	Full sample
Size Indicators				
Utilised agricultural area (ha)*	43	57	43	51
Total livestock units*	68	99	107	94
Percentage dairy livestock	62	61	64	62
Milk quota litres***	195,000	285,000	320,000	290,000
Farm Economic Indicators				
Family farm income (€)	36,000	42,000	43,000	41,000
REPS payment € ***	6,250	-	-	-
Net margin (€/ha) (excl REPS)***	704	908	1,011	854
Net margin (€/ha) (incl REPS)	861	-	-	-
Net margin (€/labour) (incl REPS)	26,743	25,885	28,333	26,659
Dairy Enterprise Economic Indicators				
Direct costs cent per litre ***	9.4	9.5	10.3	9.6
Overhead costs cent per ltre	8.5	9	8.7	8.8
Dairy net margin cent per litre	12	11.6	10.7	11.5
Technical Indicators				
Litres produced per cow	4810	5116	5283	5085
Nitrogen kg/ha (grassland) ***	133	177	243	183
Nitrogen kg/ha (grazing) ***	99	131	243	172
Concentrates per cow (kg)***	726	808	993	814

***- significant at the 99% level, **- significant at the 95% level, *- significant at the 90% level

The more intensively stocked farms are producing a significantly higher profit per hectare of land farmed (€1,011 per hectare for those over 170Kg per hectare, compared to an average of €854). When REPS payments are included the farms in the REPS scheme are operating only slightly below the non-REPS farms in the less than 170kg per hectare group. The net margin per labour unit employed is higher on the more intensively stocked farms but the difference is not significant.

The results show only marginal differences in the average milk deliveries per cow across the groups and the differences are not significant. Figure 5 graphs the distribution function of yield per cow for the different groups. There is a larger percentage of the more intensive farms (>170) supplying milk at 4,000 litres or less, (15% of >170 farms compared to 11% of <170 farms) and there is smaller percentage of them supplying milk at 6,000 litres or more. However the majority of intensively stocked farms have higher milk yields than their more extensive counterparts. About 40% of intensive farms have yields of between 5,000 and 6,000 litres compared to just 28% of the farms operating at 170kg N per hectare or less.

Figure 5. Milk yields per cow for farm groups



The results show that on average, farms operating at 170kg N per hectare or higher tend to have higher direct costs of production (10.3 cent per litre relative to an average across all farms of 9.6 cent). The concentrates fed per cow and the chemical nitrogen applied per hectare are higher on the more intensively stocked farms, this contributes to the higher direct costs per litre. While the overhead costs are marginally lower on the more intensively stocked farms, the difference is not significant. Additionally the difference in total costs of production per litre of milk produced and net margin per litre are relatively small and statistically not significant.

It seems then that the more intensively stocked farms have significantly higher direct costs of production, and while on average they have a lower net margin per litre produced, the difference is not statistically significant. Additionally when the whole farm is considered these farms have a higher profit per hectare and per labour unit than the other two groups.

Nitrogen use for milk production

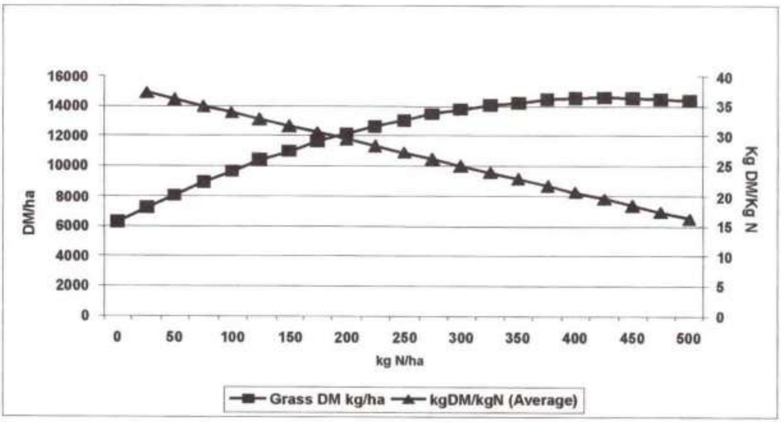
Profitable dairy farming in Ireland depends on a high volume of milk sales off the farm. This can best be achieved by achieving high milk yield per cow at relatively high stocking rates from grazed grass. This system depends on strategic application of fertilizer nitrogen over the grazing season. The level of fertilizer nitrogen will be influenced by:

- Grass DM response to fertiliser nitrogen,
- The cost of the fertilizer nitrogen relative to milk price,
- The cost of alternative feeds to grazed grass,
- The ability of the dairy farmer to use the extra grass DM produced to increase milk output,

- Compliance with fertilizer regulations and environmental implications.

Grass DM response to fertiliser nitrogen
Figure 6 shows the relationship between nitrogen fertilizer application rate and grass DM production (obtained from a range of grass cutting experiments in Teagasc over a large number of years). The results show that in a zero nitrogen situation grass production was 6.25 tonnes DM/ha, increasing to approximately 9.5 tonnes at 100kg N/ha, 12.0 tonnes at 200kg N/ha, 13.0 tonnes at 250kg N/ha, 13.8 tonnes at 300kg N/ha, and 14.2 tonnes at 350kg N/ha. Marginal responses ranged on average from >30kg DM/kg N for N fertiliser rates less than 100kg N/ha; 20 to 30kg DM/kg N for N fertiliser rates of 100 to 225kg N/ha; 10 to 20kg DM/kg N for N fertiliser rates of 250 to 325kg N/ha and less that 10kg DM/kg N for N fertiliser rates greater than 325kg N/ha.

Figure 6. Influence of nitrogen level on grass dry matter production

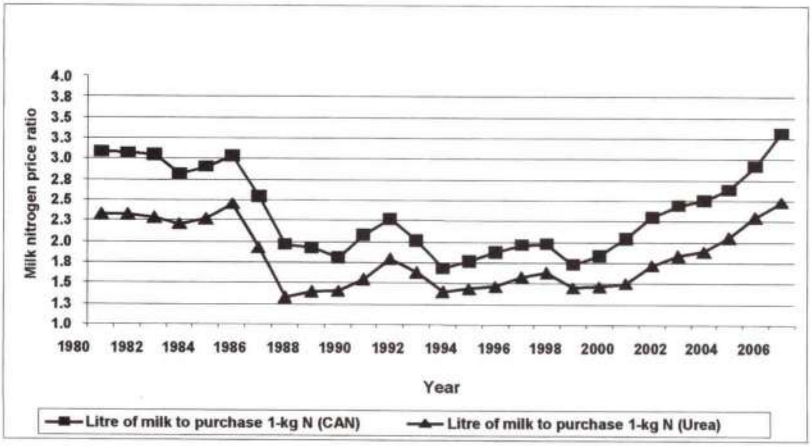


More recent research has shown differences in background release of N from soil due to soil type (O'Connell, *et al.*, 2005). The quantities of N released ranged from 74kg N /ha on shallow heavy-textured and poorly drained soils to over 200kg/ha on deep, loamy soils that were moderately to well-drained. The response to fertiliser N will therefore depend on soil type (background release of N from the soil).

The cost of the fertilizer nitrogen relative to milk price
Figure 7 shows milk nitrogen (both CAN and urea) price ratio from 1980 to 2006. Both in the early 1980's and similarly over the last two years the milk nitrogen price ratios are not as favourable as they were from 1987 to 2002. The unfavourable relationship in the early 1980's was the result of lower milk price and a fuel shortage over that period. The less unfavourable relationship at present is mainly due to the higher energy costs at present. It can be assumed that this relationship will not

improve in the near future as energy costs are predicted to remain high and milk price remaining static at best.

Figure 7. Nitrogen milk price ratio



<u>The cost of alternative feeds to grazed grass</u>

Table 7 shows the relative cost of grazed grass, grass silage, maize silage and concentrate feeds on a DM basis (with and without land costs) and on a UFL basis at land rental charges of €250, €350 and €450/ha. Grazed grass was costed using both good grassland management (stocking rate of 2.47 cows/ha, 300kg of concentrate fed/cow, nitrogen application rate of 285kg/ha and a milk output of 500kg milk solids/ha) and the average of that being achieved by specialist dairy farmers in the National Farm Survey (NFS) (stocking rate of 1.90 cows/ha, 700kg of concentrate fed/cow, nitrogen application rate of 170kg/ha and a milk output of 350kg milk solids/ha). This difference in efficiency represents a difference of almost €130/cow in feed costs based on an annual intake/cow of 3.5 tonnes at a rental charge of €350/ha.

Compared to grazed grass on a energy basis and using a rental charge of €350/ha, first cut silage was 2.5 times as expensive, second cut silage 2.9 times as expensive and concentrates (at €200/tonne) 3.5 times as expensive. Maize silage was of similar cost as first cut silage but less expensive than second silage. These results indicate that on a grazing platform, grazed grass should be optimised, first cut silage used as winter feed, and both concentrate feed and second cut silage should be kept to a minimum. Maize silage production should not form part of a system within the grazing platform. In a situation where the grazing platform is not adequate to produce feed then maize silage is the best alternate based on Table 7.

Table 7. The relative cost of grass, silage and concentrate feed

	Grass (Good management)	Grass (NFS)	First cut grass silage	Second cut grass silage	Conc. €160/t	Conc. €200/t	Conc. €240/t	Maize silage (No-plastic)	Maize silage (With-plastic)
Land cost (€250/ha)									
Total costs (€/tonne DM)	47	85	117	133	187	234	281	119	115
No land costs (€/tonne DM)	33	47	92.0	112	-	-	-	94	96
€/1000 UFL	54	84	146	173	177	221	265	150	140
Relative to grass total cost UFL	1	1.6	2.7	3.2	3.3	4.1	4.9	2.8	2.6
Land cost (€350/ha)									
Total costs (€/tonne DM)	63	100	127	142	187	234	281	128	123
No land costs (€/tonne DM)	33	47	92	112	-	-	-	94	96
€/1000 UFL	63	99	158	184	177	221	265	160	150
Relative to grass total cost UFL	1	1.6	2.5	2.9	2.8	3.5	4.2	2.5	2.4
Land cost (€450/ha)									
Total costs (€/tonne DM)	72	116	136	150	187	234	281	138	131
No land costs (€/tonne DM)	33	47	92	112	-	-	-	94	96
€/1000 UFL	71	114	170	195	177	221	265	180	160
Relative to grass total cost UFL	1	1.6	2.4	2.7	2.5	3.1	3.7	2.5	2.3

The relative competitive advantage of grazed grass is expected to improve over the next number of years, due to high concentrate price and continued increasing cost of grass silage. Reduced production of grain around the world in 2007, combined with strengthening demand, is shrinking global stocks and is causing prices to increase to the highest levels in a decade. World wheat prices have climbed as exportable supplies are down sharply in key Northern Hemisphere regions such as United States, Black Sea region and the European Union. This tightness has been exacerbated by a severe crop shortfall in Australia and strong import demand in India. Surging corn prices are being driven by a smaller US crop and strong demand for use in ethanol and exports. Barley prices have also jumped to a decade high as a result of sharply lower exportable supplies in Australia (the largest exporter in the past 3 years) as well as strengthening feed demand in light of poor wheat crops. In China domestic demand continues to rise as the livestock and poultry sectors are experiencing rapid growth and industrial use of corn is expanding. Greater consumption is largely due to higher incomes and urbanisation. As a result of this strong growth, stocks are forecast to continue shrinking while exports are expected to remain at just a quarter of the level of 5-years ago. The reduced global supplies has caused EU prices to climb to a 10-year high and the Commission has begun to sell intervention stocks onto the domestic market to curb prices. Attractive international prices have allowed the commission to sell large amounts of intervention grain for export, at prices about $50 above acquisition costs. This has led to dramatic reduction in intervention stocks, particularly for wheat and barley. Conserved feed costs (both grass silage and maize) will continue to increase relative to grazed grass due to increases in contractor charges associated with inflation in labour, energy and machinery costs.

<u>The ability of the dairy farmer to use the extra grass DM produced to increase milk output</u>

A number of studies were carried out at Moorepark from 1978 to 1982 to measure milk production and stock carrying capacity responses to nitrogen levels in excess of 270kg N/ha. Table 8 summaries the results of a three year study (1978 to 1980) comparing two nitrogen rate (270 and 490kg N/ha) at two stocking rates (2.5 and 3.1 cows/ha at 272kg N/ha; 2.7 and 3.4 cows/ha at 495kg N/ha) (McCarthy, 1982). Over the three years of the trial the response to the higher nitrogen input was poor in terms of increased milk production. To claim a response the milk yield per cow from the high nitrogen groups, 2.5 and 3.4 cows/ha should be equal or greater than the milk yield per cow from the systems at 272kg N/ha at equivalent stock densities, i.e. stocking rates 2.7 and 3.4 cows/ha respectively. The response was greater at the higher stocking rate (3.4 cows/ha versus 2.7 cows/ha). The results also show a much greater increase in milk production per hectare from the increased stocking rate than from the increased nitrogen input/ha.

Table 8. Effect of stocking rate and nitrogen input on milk production (1978-80)

Nitrogen (kg/ha)	270		490	
Stocking rate (cows/ha)	2.5	3.1	2.7	3.4
(organic N/ha)	(213)	(264)	(230)	(290)
Milk yield/cow (kg)	4,717	4,420	4,611	4,368
Milk yield/ha (kg)	11,651	13,657	12,678	14,985
Increase relative 270 @ 2.5	-	+17%	+9	+28

Source: McCarthy 1982

Table 9 summarises a follow on study carried out over two years (1981 and 1982) using an intermediate level of 390kg/ha at a stocking rate of 3.1 cows/ha (McCarthy, 1983). At a stocking rate of 3.1 cows/ha, increasing the nitrogen use from 270 to 390kg N/ha increased milk yield per cow by 173kg and milk output per hectare by 536kg. Using present day nitrogen price (80 cent/kg) and milk price (25 cent/kg) the advantage to the higher nitrogen application rate would be €38/ha (€134-€96). This modest increase in profit was achieved at a stocking rate that is higher than what is allowed under the new nitrate regulations (2.9 cows/ha). This study also shows the large increase in milk production/ha at the higher stocking rate.

Table 9: Effect of stocking rate and nitrogen input on milk production (1981-82)

Nitrogen (kg/ha)	270	270	390
Stocking rate (cow/ha)	2.5	3.1	3.1
(organic N/ha)	(213)	(254)	(264)
Milk yield/cow (kg)	4,945	4,655	4,828
Milk yield/ha (kg)	12362	14429	14965
Increase relative 270 @ 2.5	-	+17%	21%

Source: McCarthy 1983

A number of management practices are being applied on good dairy farms nowadays that will reduce the nitrogen requirement for any given stocking rate:

- Greater use is being made of slurry on dairy farms nowadays. On many Moorepark farms 3000 to 4000 gallons of slurry is being applied in late March on ground used to produce first cut silage. This has allowed for a reduction in nitrogen application rates for first cut silage by between 30 and 40 kg/ha.
- Better grazing management in both spring and autumn by using grass budgeting has allowed for increased efficiency in N usage. This has been achieved by using longer rotation lengths and reduced requirement for silage.
- New grass varieties are capable of greater grass production in both spring and autumn therefore reducing the requirement for nitrogen at a period in the year of greatest requirement.

Compliance with fertilizer regulations and environmental implication

Table 10 shows the new fertilizer recommendations based on S.I. No. 378 in Zone A.

Table 10. New nitrogen and phosphorus fertilizer regulations in Zone A

Stocking rate (cows/ha)	Organic N (kg/ha)	Nitrogen rate (kg/ha)	Phosphorus* (kg/ha)
≤ 2.0	≤ 170	210-217	8
2.0-2.47	171-2.0	287-289	10
2.47-2.94	211-250	256-260	13

*Based on 700-kg of concentrates/cow and 25% of farm on P-index 1, 2, 3 and 4 respectively

Table 11 shows the average N, P and K application rates used in specialist dairy farms for grazing from 2001 to 2003. The N usage at stocking rates greater than 2 LU/ha do not significantly differ from Teagasc advice, while at lower stocking rates the actual N usage is significantly greater than the advised rates (Coulter, 2004). Assuming that the surveyed farms had the same distribution of soil analysis levels as the laboratory samples, the P usage on farms greater than 2.1 LU/ha and K usage on all farms were less than Teagasc advice. The level of P usage on farm with stocking rates less than 2.1 LU/ha was in good agreement with Teagasc advice. The nitrogen and phosphorus levels allowed under the new regulations are very similar to that being used on specialist dairy farms based on National Farm Survey data (Table 8). Similarly the fertilizer rates used on monitor farms in 2005 were also similar to that being allowed in S.I. No. 378.

Table 11. Fertilizer application rates used on specialised dairy farms for grazing (kg/ha)

Stocking rate (LU/ha)	Nitrogen (kg/ha)	Phosphate (kg/ha)	Potassium (kg/ha)
>1.2	77	6	16
1.2-1.5	100	10	23
1.5-1.9	134	9	21
2.0-2.25	177	11	26
2.25-2.6	216	13	26
2.6-2.9	258	12	29

To date, phosphorus advice for grassland has been based on soil phosphorus - *index system: 1* building up soil phosphorus reserves to the target index, and *index 2* maintaining soil-test phosphorus at the target index by replacing off-take of phosphorus in meat and milk (Coulter *et al.*, 2004). Soils in *Index 1* are phosphorus-deficient, and require build-up of soil phosphorus-reserves. The optimum soil-test phosphorus ('target index') depends on farm intensity, and corresponds to *Index 3* where early grass is required and where herbage production is highly utilized. Soils in *Index 4* have elevated phosphorus-reserves, and do not exhibit responses to additional fertiliser phosphorus. The S.I. No. 378 phosphorus advice for grassland is still based on a soil phosphorus index system, where the soil phosphorus range for soil *Index 3* have been reduced from a range of 6.1 to 10 mg/litre, to 5.1 to 8.0 mg/litre. However this change in soil phosphorus range (using the best scientific data available) in soil *Index 3* will not reduce animal performance from intensive grassland farming.

The new nitrogen fertilizer recommendations (S.I. No. 378) are higher at the lower stocking rates (less than 2 cows/ha) and lower at the higher stocking rates (greater than 2.47 cows/ha) than that currently recommended by Teagasc (Coulter, 2004). These differences are probably a reflection in differences in background release of N as a result of soil type (O'Connell *et al.*, 2005). Based on NFS data and monitor farm data the levels are similar to that outlined in the S.I. No. 378. The lower N application rates at stocking rates greater than 2.47 cows/ha (210kg organic N/ha) are a requirement for the derogation to stay within a total N of 500kg/ha. However using present day less favourable milk/nitrogen price ratio and previous research data, results indicated that a fertiliser N level of 270kg/ha can support a dairy cow stocking rate in the range of 2.5 to 3.1 cows per hectare (Tables 6 and 7). This should not prohibit dairy farmers from operating efficient grass based systems.

<u>Teagasc current research on increasing nitrogen efficiency</u>

- A new project commenced in 2006 on improving the efficiency of nitrogen recovery from cattle and pig manure in order to reduce the requirement for fertiliser nitrogen. It will focus on improving the methods and timing of application and strive to improve our understanding of the soil and related processes involved and the immediate and residual availability of manure nitrogen in grassland systems.
- A study will commence in 2007 at the Dairygold Research Farm to investigate the effect of three stocking rates (2.0, 2.47 and 2.94 cows/ha) and a range of fertiliser N application rates (185 to 325kg N/ha) on nitrogen leaching and stocking carrying capacity on a free draining soil. This new research programme will investigate a range of management practices with the objective of increased nitrogen efficiency and reducing nutrient losses to the environment.
- The research programme over the last five years at the Solohead Research Farm has demonstrated the potential of including white clover to reduce fertiliser N requirement. The study has demonstrated that an established white clover grass based system using 90kg N/ha and stocked at 2.0 cows/ha produced similar milk production per cow as a grass only sward stocked at 2.2 cows/ha and using 226 kg N/ha.

Optimum systems of milk production in a low and high stocking scenario

Prior to the introduction of milk quotas in Ireland in the mid-1980's the optimum system of milk production was based on spring calving, a stocking rate of 2.5 to 3.0 cows/ha, a concentrate input of 500 to 750kg/cow and a nitrogen application rate of 270 to 300kg N/ha (Crosse, 1988). However, with the introduction of milk quotas on dairy farms, the emphasis shifted from maximising performance per hectare to maximising performance per kg of milk quota on the farm. In this scenario where land is not limiting or has a low opportunity cost it may be justifiable to allocate the extra land by means of a lower stocking rate to the dairy enterprise rather than to an alternative enterprise. The shift to lower stocking rates was further rewarded through the introduction of REPS. However in a future scenario in the in the absence of EU milk quotas and REPS payment, dairy farm profitability will be maximised at relatively high stocking rates (2.5 to 2.8 cows/ha) resulting in a reduction in milk output of approximately 10% (McMeekan and Walsh,1963).

At present and into the future it could be envisaged that two broad systems of milk production will develop in Ireland:

- Rural Environment Protection Scheme (REPS) based milk production system;
- High output per hectare systems based on high stocking rate and grass utilisation.

The decision by dairy farmers on which system to opt for over the coming years will be influenced by such factors as the availability of milk quota, conditions applying to REPS 4, compliance factors in relation to obtaining a derogation at farm level, the availability of land and the 2008 review of CAP. The technical factors that will be important in maximising farm profitability will be very similar for both systems of milk production.

Based on the stocking rates on REPS systems of milk production, there is a requirement to further reduce both N and concentrate fed/cow. Nitrogen costs can be reduced by relying on white clover to reduce fertiliser N requirement. Concentrate input can be reduced with better grazing management and greater use of grass budgeting.

On intensive grass based systems farm profitability will be maximised at relatively high stocking rates (2.5 to 2.8 cows/ha) using a nitrogen input of 270 to 300kg N/ha and a concentrate input of less than 500kg/cow. The cow type is also important in that it produces a relatively high milk yield of high milk constituents; maintains a 365 day calving interval, has high survival traits and is an efficient converter of grazed grass into milk. A target milk production will be in the region of 1200 to 1400kg of milk solids/ha (fat plus protein).

Conclusion

Very high level of grass DM production over a long season is possible under Irish climatic conditions. The combination of the generally lower stocking densities and lower milk solids per cow for Ireland, results in Ireland having the lowest milk solids per hectare compared with all other countries with the exception of France. This should be viewed as an opportunity in the future in a more liberalised milk quota regime to increase milk production on dairy farms where presently milk quota is limiting. Specialist dairy farmers participating in REPS scheme have smaller milk quota size, achieved a higher net margin per litre but achieved a lower Family Farm

Income and net margin per hectare. The new nitrogen and phosphorus fertilizer regulations will not prohibit dairy farmers from operating efficient grass based milk production systems. In Ireland pasture based dairy farming is and will be in the future the most profitable enterprise when based on the efficient conversion of grazed grass into milk. On intensive grass based systems farm profitability will be maximised at relatively high stocking rates (2.5 to 2.8 cows/ha) using a nitrogen input of 270 to 300 kg N/ha and a concentrate input of less than 500 kg/cow.

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Increasing milk value

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Introduction

Dairy farmer profitability is comprised of receipts for milk and livestock, less the costs associated with producing milk. Approximately 90% of the sales from the farm come from the sale of milk. The price a farmer receives for milk should be directly related to the yield and value of the milk products that can be produced, less the processing costs. Milk pricing systems are a method of communication between the processor and the dairy farmer. Within this communication the processor should provide a clear indication to the farmer of the type of milk required and when it should be supplied. If this communication is functional, and dairy farmers respond to the signals of the processor, both the farmer and the processor should gain substantially. To this end dairy farmers should be rewarded for milk that increases the profitability of the industry (farmer and processor), while at the same time milk that is reducing the profitability of the industry (farmer and processor) should be penalised. The objective of this paper is to examine the effects of changing the milk pricing systems currently operated by most milk processors in Ireland, to a system that rewards dairy farmers for producing milk that will increase the profitability of the industry. The paper analyses the effect of two areas of milk payment:

(1) A+B-C
(2) Ratio of fat to protein

A+B-C

The A+B-C system (Multi Component Price System, MCPS) of milk payment is used in many countries around the world (e.g. Denmark, Holland, Australia, New Zealand, etc.). This system operates by putting a value on each kg of protein and fat supplied by the farmer to the processor, and subtracting a cost for collection and processing all of the milk supplied. This methodology is substantially different to the system currently operated by many of the processors in Ireland. The system operated by many of the processors is the differential milk payment system where each 0.1% change in fat and protein is rewarded while there are no processing costs deducted. Therefore, the increased milk price achieved at farm level for increasing milk solids is less under the Irish milk payment systems when compared to the systems operated using the A+B-C systems. When dairy farmers are not adequately rewarded for increasing milk solids they do not put as much emphasis as they should on increasing milk solids, this ultimately results in increasing costs to the industry as a whole.

The Irish and New Zealand dairy industries are similar in that most milk is seasonally produced, and is primarily used for manufacturing and export. Table 1 shows the average milk production and composition per cow for both Ireland and New Zealand. Average milk yield per cow in Ireland is approximately 4,649kg, containing approximately 325kg of milk solids (fat and protein), while in New Zealand the average milk yield is 3,942kg, with 324kg milk solids. Therefore, for the Irish dairy industry to process a similar level of milk solids per cow as in New Zealand, an extra 700kg of milk carrier (mostly water plus lactose) must be processed. Based on a processing cost of 6c/l of milk, it is estimated that this additional water costs the Irish dairy industry (farmer and processor) €42/cow or €50,000,000 annually. When the dramatic increases in energy and labour costs observed over the past number of years (CSO 2007) is included, it is clear that the processing and transport costs of milk at processor level have increased sharply in recent times. As these rates of increase in labour and energy costs show no signs of abating, the costs associated with processing milk in the future will continue to increase and the potential benefit of moving to a system that rewards high solids milk, thereby reducing the volume of water for a given level of product, will be even more beneficial.

Table 1. Milk yield, protein %, fat % and milk solids yield per cow per year in Ireland and in New Zealand

	Milk Yield (kg)	Protein (%)	Fat (%)	Milk solids (kg)
Ireland	4,649	3.28	3.71	325
New Zealand	3,942	3.54	4.68	324

The value of A (kg/protein, €/kg), B (kg/fat, €/kg) and C (the costs to process a litre of milk, €/litre) are specific to each processor. They are dependent on the product portfolio of the processor, the margin for the products produced and the costs associated with processing one litre of milk. The C component of the milk payment may differ between processors for varying reasons. Berry *et al.*, (2004) reviewed total milk processing costs in Ireland in 2004 and showed that the average costs of processing milk were 5.92c/l. In many cases the total costs of processing milk will not be included when developing an A+B-C system; it will be only the variable costs associated with the C component that will be included. The proportion of the processing cost included in the milk price has a large effect on the benefits gained or not from increasing milk solids. The larger the proportion of the processing costs that are included in the pricing systems, the greater the benefit will be realised from increasing milk solids at farm level.

Effect on milk price

A recent review of milk payment systems in operation in Ireland (Kennedy, 2005) concluded that a differential milk payment system (each 0.1% change in fat and protein in the milk is given a value) is used by most processors, with each processor having different weightings on the value of fat and protein. A second system used by some processors involves the payment of a flat rate on a portion of the milk price in combination with a differential payment system, resulting in a lower differential for fat and protein %. The results of this survey prompted a study comparing three systems of milk payment on the average, highest 10% total solids and lowest 10% total solids on milk price and overall milk receipts of a large group of 9,186 suppliers with

496,862,924 gallons of milk. The two systems currently in operation in Ireland were compared with the A+B-C system. The three systems were set up so that the milk receipts were the same across milk payment systems at the average milk solids percentage of the 9,186 farmers, therefore the systems were price neutral at processor level. The components of the milk pricing systems are shown below:

1. Differential pricing system where a 0.1% change in fat and protein resulted in 0.25c/l and 0.45c/l change in milk price, respectively.
2. Differential pricing system with a constant where a 0.1% change in fat and protein resulted in 0.178c/l and 0.321c/l change in milk price with a constant of 7.0c/l.
3. Two MCPS
   (a) 1kg of fat and protein were valued, respectively, at 310c/kg and 559c/kg with processing costs of 5.92c/kg for milk.
   (b) 1kg of fat and protein were valued, respectively, at 291c/kg and 523c/kg with processing costs of 4.0c/kg for milk.

Table 2. The effect of three alternative milk pricing systems on milk price with milk of varying compositions of fat and protein content

	Average	Highest Total Solids 10%	Lowest Total Solids 10%
Protein %	3.32	3.47	3.18
Fat %	3.81	4.05	3.59
Milk price differential (c)	25.77	27.10	24.51
Milk price differential with constant (c)	25.77	26.72	24.87
Milk price (MCPS) A+B-C (c)	25.77	27.31	24.20

Table 2 shows the average protein and fat percentage of the group of suppliers as well as the lowest 10% and highest 10% of total milk solids. The average of the group had a protein percentage of 3.32% and a fat percentage of 3.81%, while the 10% lowest group had a protein content of 3.18% and a fat percentage of 3.59% and the 10% highest solids group had a protein percentage of 3.47% and a fat percentage of 4.05%. These differences have a large effect on milk price irrespective of the method of payment. There is a 2.59c/l, 1.85c/l and a 3.11c/l difference between the highest and lowest groups with the differential, differential plus a constant and the A+B-C systems of milk payment, respectively. The highest milk price with high total solids is achieved with the A+B-C system, while at the same time the lowest milk price is achieved with the A+B-C system with the lowest total solids. The differential milk payment system is intermediate with the differential plus a constant milk payment system paying the lowest for high solids milk while at the same time paying the highest for low solids milk. Therefore, within the current milk payment systems increasing total milk solids is not adequately being rewarded by the differential system or the differential plus a constant system.

Effect on milk receipts

The effect of an A+B-C system of milk payment on Irish milk producers milk receipts was calculated using data from 9,186 suppliers that supplied over 496,862,924 gallons of milk to various Irish processors in 2005. The A+B-C system of milk payment was compared to the payment system being used by the processors currently. The ratio of the value of protein to fat was not altered. The analysis was carried out with two different C values reflecting either the inclusion of total processing costs (5.92 c/l) or the inclusion of variable costs only (4.0 c/l). The analysis was carried out to demonstrate the effect on each individual supplier within the group. The suppliers were then grouped into categories based on the gains or losses that were achieved at farm level.

Table 3. The effect of an A+B-C system of milk payment on milk suppliers at two different C levels when compared to the differential milk payment system

	€	Processing Costs 4.0c/l		Processing costs 5.92c/l	
		Gain/Loss Number	Gain/Loss (%)	Gain/Loss Number	Gain/Loss (%)
Loss	5000-6000	-	-		-
Loss	4000-5000	-	-	1	0.0
Loss	3000-4000	1	0.0	3	0.0
Loss	2000-3000	3	0.0	11	0.1
Loss	1000-2000	37	0.4	128	1.4
Loss	750-1000	67	0.7	159	1.7
Loss	500-750	200	2.2	471	5.1
Loss	0-500	4848	52.8	4397	47.9
Gain	0-500	3552	38.7	3147	34.3
Gain	500-750	279	3.0	407	4.4
Gain	750-1000	98	1.1	205	2.2
Gain	1000-2000	78	0.9	207	2.3
Gain	2000-3000	15	0.2	27	0.3
Gain	3000-4000	6	0.1	13	0.1
Gain	4000-5000	3	0.0	7	0.1
Gain	5000-6000	-	-	1	0.0
Gain	6000-7000	-	-	1	0.0
Gain	>10,000	-	-	2	0.0

The analysis shows that when the A+B-C systems with a C value of 4.0c/l is compared to the differential milk pricing systems, 91.7% of suppliers are within the losing €500 to gaining €500 category. Both the losers and those gaining from the system are spread evenly. There are a small number of people that lose up to €4000 and there are a small number of producers that gain up to €5000. When the same exercise is completed with a C value of 5.92c/l the variation between winners and losers is higher. There are now 82.2% of producers in the losing €500 to gaining €500 category less than when the C value was lower. There are also higher numbers of producers gaining and losing higher amounts of money with the higher C value.

Table 4. The effect of an A+B-C system of milk payment on milk suppliers at two different C levels when compared to the differential plus a constant milk payment system

	€	Processing Costs 4.0c/l		Processing costs 5.92c/l	
		Gain/Loss Number	Gain/Loss (%)	Gain/Loss Number	Gain/Loss (%)
Loss	>8000	0	-	0	-
Loss	7000-8000	1	0.0	3	0.0
Loss	6000-7000	2	0.0	0	-
Loss	5000-6000	1	0.0	4	
Loss	4000-5000	8	0.1	10	0.1
Loss	3000-4000	22	0.2	33	0.4
Loss	2000-3000	78	0.8	138	1.5
Loss	1000-2000	557	6.1	704	7.7
Loss	750-1000	424	4.6	497	5.4
Loss	500-750	803	8.7	798	8.7
Loss	0-500	3286	35.8	2997	32.6
Gain	0-500	2371	25.8	2177	23.7
Gain	500-750	495	5.4	499	5.4
Gain	750-1000	338	3.7	353	3.8
Gain	1000-2000	576	6.3	655	7.1
Gain	2000-3000	139	1.5	194	2.1
Gain	3000-4000	37	0.4	57	0.6
Gain	4000-5000	14	0.2	27	0.3
Gain	5000-6000	9	0.1	8	0.1
Gain	6000-7000	10	0.1	6	0.1
Gain	7000-8000	8	0.1	13	0.1
Gain	>10,000	4	0.0	9	0.1

The analysis shows that when the A+B-C system with a C value of 4.0c/l is compared to the differential plus a constant milk pricing system, 61.6% of suppliers are within the losing €500 to gaining €500 category. This compares to a figure of 91.7% of producers in this category when the differential system was compared to the A+B-C system. Again winners and losers between the two milk payment systems are relatively evenly spread. However, the spread in milk receipts is substantially wider than when compared to the differential system. There are a larger number of suppliers in the losing and gaining larger amounts of money than is the case when the differential systems are compared to the A+B-C systems. When the same exercise is completed with a C value of 5.92c/l the variation between winners and losers is again higher, similar to when the exercise is completed with the differential system. There are now 56.3% of producers in the losing €500 to gaining €500 category. There are also higher numbers of producers gaining and losing larger amounts of money with the higher C value.

The majority of the milk payment systems in Ireland currently operate through a differential system. This analysis has shown that the A+B-C system of milk payment will not have a dramatically negative impact on milk price for a large proportion of suppliers when compared to the differential milk payment systems. When the A+B-C system of milk payment is compared to the differential plus a constant system there are larger numbers of suppliers gaining and losing larger amounts of money than when compared to the differential system.

Ratio of Protein to Fat

Within any milk pricing system the value of 1kg of protein and 1kg of fat must be related to the market returns that are achievable from the products of these constituents. Therefore, there may be large differences in the value of 1kg of protein versus 1kg of fat between processors based on their product portfolio. A recent study carried out by Simms and Thompson (2006) showed that the milk payment systems operated in Ireland vary substantially in relation to the ratio of fat to protein and the value not attached to protein and fat. Table 5 shows that the value of a 0.1% change in protein relative to fat changes from 1.1 to 1 in Newmarket Co-op to the highest differential of 2.5 to 1 in Centenary Thurles Co-op. The review carried out by Simms and Thompson also highlighted the fact that all except two processors (Bandon Co-op and Tipperary Co-op) had a positive payment on volume within their milk pricing systems. This payment ranged from a positive 6.8c/l in Lakeland Dairies to a negative 1.9c/l in Tipperary Co-op.

Table 5. Summary of the milk payment systems operated in Ireland (review of milk payment systems carried out by Simms and Thompson in September 2006)

	Butterfat Adj per 0.1%	Protein Adj per 0.1%	*Protein to Fat Ratio*	Implied Milk Price	Actual Milk Price	Implied Adjustment
Dairygold	0.28	0.46	*1.6*	25.3	26.70	1.4
Kerry	0.25	0.49	*2.0*	25.2	26.70	1.5
Newmarket	0.34	0.37	*1.1*	24.5	26.65	2.2
North Cork	0.3	0.4	*1.3*	24.0	26.65	2.7
Bandon	0.25	0.56	*2.2*	27.5	26.35	-1.1
Centenary Thurles	0.2	0.5	*2.5*	23.7	26.00	2.3
Tipperary	0.25	0.56	*2.2*	27.5	25.60	-1.9
Wexford	0.27	0.46	*1.7*	24.9	25.50	0.6
Lakelands	0.17	0.37	*2.2*	18.3	25.14	6.8
Arrabawn	0.29	0.4	*1.4*	23.6	25.02	1.4
Glanbia	0.25	0.46	*1.8*	24.2	24.60	0.4
Connacht Gold	0.24	0.4	*1.7*	21.8	24.25	2.4

Source: Joe Rea May 2006 Milk Price League
Based on 3.6% fat and 3.3% protein

The relative value of protein to fat has been historically higher within the EU when compared to other countries around the World (e.g. Australia and New Zealand). This is largely because in the past there were high levels of support for butter within the EU, through intervention, export refunds, etc. However, this support for butter fat has reduced substantially (-25%) in recent times as a result of the Luxembourg Agreement, and is projected to reduce further if export refunds are abolished as part of the World Trade Organisation (WTO) Agreement. The current world market price could possibly be the best indicator of where the value of protein will lie relative to fat in the future within Europe when the support on fat is reduced. Simms and Thompson 2006 (Table 6) compared the current EU and world price ratios with possible future ratios as a result of the reform of EU CAP policy and the reform of the WTO Agreement. The results show that the ratio of protein to fat is running between 2.6 and 3.0 at world level while within the EU it is between 1.5 and 1.9. The report shows that if the support for butter was reduced by a further 10% the ratio would be 2.0 to 1.0, while if it was reduced a further 25% the ratio would be 2.7 to 1.0.

Table 6. Summary of the relative value of protein to fat under various scenarios

		Relative Value of Milk in %		Ratio of Value per 1kg	
		Fat	Protein	Fat	Protein
USDA[1] Oceania World Price	Current	0.27	0.73	1	2.9
USDA Europe World Price	Current	0.25	0.75	1	3.3
USDA Europe World Price	2015f	0.29	0.71	1	2.6
US Domestic Price	Current	0.43	0.57	1	1.5
US Support Price	Current	0.41	0.59	1	1.6
US Support Price	Jan-00	0.23	0.77	1	3.8
EU 2000	2000	0.42	0.58	1	1.5
EU MTR[2]1	Jul-04	0.42	0.58	1	1.5
EU MTR2	Jul-05	0.41	0.59	1	1.6
EU MTR3	Jul-06	0.41	0.59	1	1.6
EU MTR4	Jul-07	0.39	0.61	1	1.7
Future EU Reform (Butter -35%)	2008-2013	0.36	0.64	1	2.0
Future EU Reform (Butter -50%)	2008-2013	0.29	0.71	1	2.7
Official Dutch Quotation	Current	0.37	0.63	1	1.9
IDB[3] Purchase Price	Current	0.37	0.63	1	1.9

[1]United States Department of Agriculture
[2]Mid-Term Review (CAP)
[3]Irish Dairy Board

The effect of changing the ratio of milk payment away from its current 1.8 to 1 was calculated using the same 9,186 suppliers that supplied over 496,862,924 gallons of milk in 2005 as was used in the analysis of the A+B-C milk payment systems. The A+B-C system of milk payment was compared to the differential system of milk payment to determine the effect of changing the ratio of protein to fat. A processing cost (C) value of 4.0c/l (variable costs only) was used in this analysis to compare the different ratios. There were 3 different ratios tested based on the Simms and Thompson (2006) report:

(A) Current ratio 1.8 to1.0

(B) 35% reduction in support for butter when compared to Agenda 2000 resulting in a ratio of 2.0 to 1.0

(C) 50% reduction in support for butter when compared to Agenda 2000 resulting in a ratio of 2.7 to 1.0

Table 7 shows the effect of the ratio of protein to fat on overall milk receipts. The analysis shows there is very little difference in total milk receipts when the current ratio of 1.8 to 1 is compared to 2.0 to 1. In both circumstances there are over 91% of suppliers in the category of losing €500 to gaining €500 when compared to the differential systems. When the ratio of 2.7 to 1 is imposed on the milk pricing system there are more suppliers gaining and losing more than €500. However, there are still over 87% of suppliers within this category, with those that are gaining and losing more than the €500 spread evenly around the winners and the losers. This analysis suggests changing the ratio of protein to fat from its current levels of 1.8 to 1.0 to either 2.0 to 1.0 or 2.7 to 1.0 will not have a large impact on total milk receipts at farm level.

Table 7. Effect of an A+B-C system of milk payment on milk suppliers at three differing ratios of protein to fat based on current prices and future predictions (current 1.8 to 1.0; future 35% cut in support for butter 2.0 to 1.0; future 50% cut in support for butter 2.7 to 1.0)

		Current1.8 to1.0		2.0 to1.0		2.7 to 1.0	
	€	Gain/ Loss No.	Gain/ Loss %	Gain/ Loss No.	Gain/ Loss %	Gain/ Loss No.	Gain/ Loss %
Loss	>8000	-	-	-	-	-	-
Loss	7000-8000	-	-	-	-	-	-
Loss	6000-7000	-	-	-	-	-	-
Loss	5000-6000	-	-	-	-	-	-
Loss	4000-5000	-	-	-	-	-	-
Loss	3000-4000	1	0.0	1	0.0	0	0.0
Loss	2000-3000	3	0.0	3	0.0	3	0.0
Loss	1000-2000	37	0.4	38	0.4	70	0.8
Loss	750-1000	67	0.7	71	0.8	110	1.2
Loss	500-750	200	2.2	210	2.3	332	3.6
Loss	0-500	4848	52.8	4758	51.8	4381	47.7
Gain	0-500	3552	38.7	3641	39.7	3731	40.6
Gain	500-750	279	3.0	266	2.9	315	4.4
Gain	750-1000	98	1.1	99	1.1	139	1.5
Gain	1000-2000	78	0.9	73	0.8	87	0.9
Gain	2000-3000	15	0.2	17	0.2	11	0.1
Gain	3000-4000	6	0.1	3	0.0	3	0.0
Gain	4000-5000	3	0.0	1	0.0	1	0.0
Gain	5000-6000	0	0.0	1	0.0	0.0	0.0
Gain	6000-7000	1	0.0	1	0.0	0.0	0.0
Gain	7000-8000	1	0.0	0	0.0	0.0	0.0
Gain	>10,000	0.0	0.0	0.0	0.0	0.0	0.0

Conclusion

The analysis presented in this paper shows that the milk pricing systems currently in operation in Ireland are not optimum. Processors are not adequately rewarding dairy farmers that produce milk high in fat and protein constituents despite the fact that milk with a high solids content results in reduced processing costs for a given level of product production. High solids milk would ultimately result in increased profitability within the dairy industry for both the farmer and the processor. Differential milk payment systems pay the same milk price for a certain level of milk solids, irrespective of the volume of milk supplied. The MCPS system acts as a double edged sword in that it rewards dairy farmers for producing milk with high solids content, while at the same time penalising farmers for producing milk with a low solids content. The costs to the dairy industry to process the additional water supplied in Irish milk is and will continue to rise, resulting in losses in excess of those currently reported (€50,000,000) when compared to the New Zealand example. If a multiple component pricing system was introduced in Ireland, dairy farmers who seek to increase the potential profitability of their herds by investing in breeding strategies would see greater benefit from their investment. The ratio of protein to fat is going to widen from the current levels as the support for butter in the EU is reduced. Current world markets are operating at 2.6 to 1.0. The analysis of over 9,000 farmers shown in this paper suggests that for a very large number of farmers there is going to be a small effect on overall milk receipts when the milk payment system changes from the current system to an A+B-C system, and when the ratios of fat to protein change. The overall advantage to the industry as a whole in terms of increased profitability through the removal of expensive water from the system should be the over riding driver for change.

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What A+B-C means for milk suppliers

Brian Reidy
Dairy Farmer, Sligo

Introduction

After training with the Farming Apprenticeship Board, Brian commenced a ten and a half-year lease of the family farm from his father in February 2001, when he entered the early retirement scheme. The farm is situated in South Sligo, on a reasonably free draining soil, comprising 82 acres around the parlour with additional ground rented. Forty-three cows produced 60,000 gallons in an all year round calving system. Fifty percent of the quota supplied liquid milk to Connacht Gold, Sligo Dairies. Some calves were finished to beef. Typical turnout was March 20, which was considered quite good for the region. Milk solids averaged 3.3% protein and 3.8% butterfat respectively. Although A.I. was used, the focus was very much on milk volume, due in the main to high milk prices, milk price structure and its weightings on solids, and the liquid quota.

On commencing the lease in 2001, the five-year plan was to increase cow numbers to 60 cows, producing 80,000 gallons. At that time, these plans were considered to be quite adventurous for the region.

The story in 2007

Much has happened in five years, both on the farm and within the dairy industry as a whole. Consequently it is important to be flexible and be able to adapt to changing circumstances.

In 2007 it is intended that 110 cows will produce 140,000 gallons milk, 50% of which is liquid, in a low cost grass based production system. Target turnout is February 1. This should be achievable as turnout in 2006 was February 6. The plan is to have +270 days at grass. The herd is 70% spring and 30% autumn calving. Autumn calving is compacted to 6 weeks and spring calving to 9 weeks. The breeding policy over the last six years has been very simple and straightforward – 'breed for fertility and milk solids'. These strategies have resulted in milk solids sold to the co-op averaging 3.51% protein and 4.04% butterfat.

Why has the plan changed?

<u>Belief</u>

Experience with the farm apprenticeship afforded the opportunity to visit some of the best-run farms in the country. These experiences instilled the belief that the original goals were attainable.

Challenge

At the time of taking over the farm, it was clear that sound professional advice was critical to achieving the targets set - maintaining the existing *status quo* was not an option if a viable dairy farm was to thrive.

Profit

There are only two ways of increasing profit from dairy farming;

Lower costs

The easiest and simplest way to lower costs was to get as much high quality grazed grass into cows as possible. This meant an early turnout date (target February 1), a long grazing season and a rigorous re-seeding policy. The entire farm has been re-seeded in the last six years.

Increase milk output/milk price

The only way of increasing on farm milk price was by producing high quality milk with good protein and butterfat levels. This is where the breeding policy of fertility and milk solids all tie together. The new pricing system introduced by Connacht Gold will increase overall Milk Price further. Also being fortunate enough to avail of re-structured milk quota was of great assistance.

What does A + B – C mean for the individual farmer?

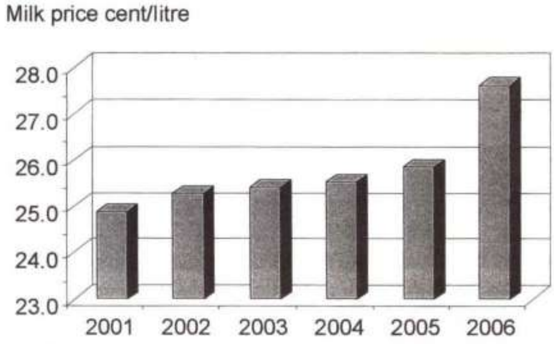
Simply, the A + B – C system rewards increased milk solids and discourages the production of low concentration milk. Therefore the pricing system will pay a premium to those individuals who have made progress in improving solids over the last few years.

By improving milk solids, the new pricing system has increased returns by nearly 3c/litre over what it would have been if milk solids and price were maintained at the 2001 level.

Table 1. The increase in milk solids 2001 – 2006

	2001	2002	2003	2004	2005	2006
Protein (%)	3.3	3.33	3.37	3.37	3.39	3.51
Butterfat (%)	3.8	3.83	3.83	3.87	3.88	4.04

Figure 1. The increase in milk price per annum based on 2006 base price and solids received in each year 2001-2006



With the introduction of the new A + B – C pricing system, and the increases in milk solids, profit will increase by 2.86 cent/litre on the manufacturing part of the quota (or €8,773 over that achieved at the old milk solid level and pricing system). Of this €1,561 is down to the new pricing system. The new pricing system lifted milk price on average for the year by 0.5c/litre. This has resulted in a complete recovery of milk price even with the reductions due to the MTR.

The new pricing system focuses on management and breeding policy going forward. To maximize revenue on the farm it is not about selling more milk, it is about selling more milk solids and at higher milk concentrations. Therefore both management and breeding strategy must be geared towards increasing protein and butterfat levels. A long-term target is to have milk concentration levels over 8% selling close to 500kg milk solids/ha.

Conclusion

Much has been achieved, but there is a lot more work to be done. Farming is changing rapidly and offers a good future for those that are willing to change. The new Connacht Gold pricing system gives clear indications as to what Co-ops are looking for when it comes to milk. To maximize revenue it will be necessary to produce a quality product that meets processor requirements, which will ultimately lead to more money in farmers pockets, which as a business is the desirable end result.

Profit from grass - a farmers' perspective

Eddie and Denis O Donnell
Athassel Abbey, Golden, Co Tipperary

Introduction

Improved milk yield/cow by getting more grazed grass into the cows has gradually increased milk production per cow from 1,223 gallons (5,724 kg/cow) in 1997 to 1,357 gallons/cow (6,351 kg/cow) supplied in 2006. At the same time milk solids/cow increased from 387 kg/cow in 1997 to 454 kg/cow in 2006. This represents an increase of 67 kg of milk solids per cow over 10 years.

We want compact breeding to better take advantage of the grazing season. In 2005 we bred for 14 weeks and in 2006 we decided to compact it even further and brought it back to 12 and half weeks.

Grazing days have gradually increased from 255 in 1997, rising to 308 in 2006. This is an increase of 53 days in 10 years.

In 1997 we spread 174 units per acre of bag nitrogen (217 kg/acre) versus 148 units/acre (185 kg) in 2006. This has been achieved mostly by reducing the amount of area cut for grass silage.

By getting figures and targets I know when to close paddocks in the autumn, reduce meal feeding and have the confidence to graze cows earlier in the spring. The net result is cows spend longer in the field and less time indoors.

If we add the cost reduction in meal and fertiliser (€6,131) and the increase in output (€6,750) this gives us a total economic benefit of €12,881/year to the farm.

Snapshot of the production system

The farm is run as a partnership, and comprises a total of 230 acres with 126 grazing acres (available to cows). Cows are milked in two parlours. On the home farm there are a total of 60 grazing acres and on the leased out farm a total of 66 acres available for grazing. The balance of the land is divided into 2 blocks and grazed mostly by dry cattle and replacements.

Land quality is sandy on the home farm with slightly heavier soils on the out farms. In general land quality is excellent for growing grass. Annual rainfall is typically 1200 mm. Good land quality and adequate rain mean the milking cows can go to grass as soon as they calve in early February.

In 2002 the farm supplied 76,000 gallons of owned quota. In 2007 the intention is to supply 120,000 gallons (561,600 kg) of milk. The increase in quota has come about by (a) setting the farm up as a registered father/son partnership and (b) the purchase of land with milk quota. In 2004 and 2005 the partnership provided the opportunity to purchase approx 18,400 gallons of milk. This was followed in 2006 by the purchase of 50 acres with 25,100 gallons of milk quota attached.

The herd is 100% spring calving, starting to calf at the end of January and continuing until end of April. The duration of the breeding season in 2005 was 14 weeks, but was brought back to 12 and half weeks in 2006. In 2005 the home farm produced 1,530 gallons per grazing acre. With the introduction of the second farm into the production system in 2006, milk quota fell to 1,250 gallons/acre. In 2007 at current milk quota the enterprise is stocked at 950 gallons/acre.

Ten year performance review

Figure 1 shows the milk yield in gallons from 1997 to 2006. Milk production per cow has gradually increased from 1,223 gallons (5,724 kg/cow) in 1997 to 1,357 gallons/cow (6,351 kg/cow) supplied in 2006. The plan over the past 10 years was to increase milk yield and milk solids per cow as efficiently as possible using grazed grass.

The enterprise has been using AI for the last 20 years. In the late 1990's it was mostly Dairygold AI sires e.g. MAU, MFX, Pigeonwood Red, CAU etc. In the early 00's a switch was made to bulls from the ICBF Active bull list (based on EBI), picking bulls such as GMI, HRZ, RUUD, LBO and Hugo.

Figure 1. Milk yield (gallons/cow) from 1997 to 2006

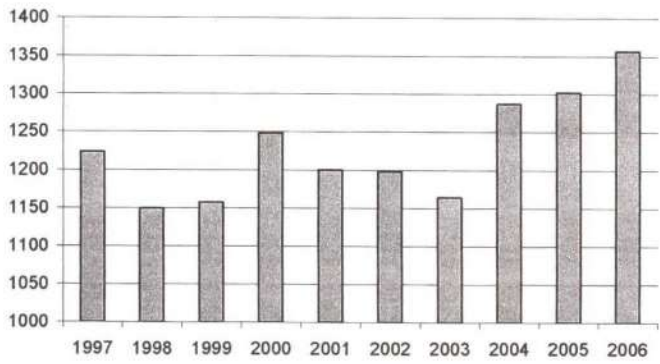
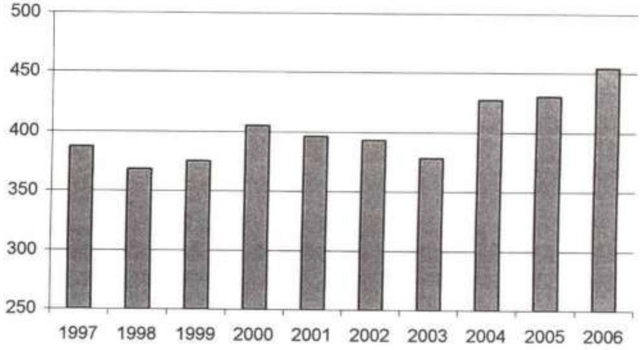


Figure 2 shows milk solids (kg) production per cow for the past 10 years. This has gradually increased from 387 kg/cow in 1997 to 454 kg/cow in 2006. This is an increase of 67kg of milk solids per cow over 10 years. Protein percentage increased by 0.20% over the last 10 years, rising from 3.14% in 1997 to 3.35% in 2006 (a disappointing result as it was 3.41% in 2005!) Fat has also increased by 0.2% over the 10-year period - from 3.63% in 1997 to 3.83% in 2006. This has come as an added bonus as bull selection criteria was always based on an increase in protein.

Figure 2. Milk solids (fat and protein kg/cow) from 1997 to 2006



The number of days/year spent grazing over the last 10 years is shown in Figure 3. Grazing days have gradually increased from 255 in 1997, rising to 308 in 2006 - an increase of 53 days in 10 years. This has resulted in significantly less silage being used e.g. in 1997 a total of 90 acres was used for first and second cut silage respectively, compared with only 50 acres for first cut silage in 2006. Thus the increase in days at grass has been accompanied by a reduction in the amount of grass silage fed to milking cows. Fertiliser application has also been reduced. In 1997, 174 units per acre of nitrogen (217 kg/acre) was spread versus 148 units/acre (185 kg) in 2006.

Figure 3. Grazing days at grass from 1997 to 2006

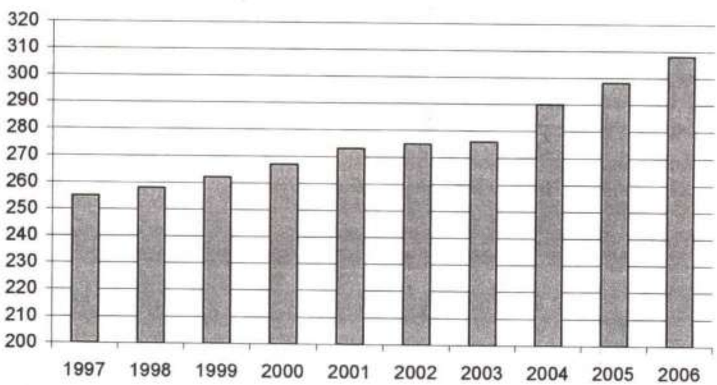
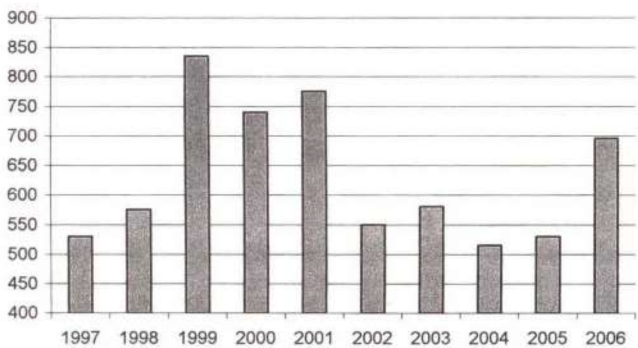


Figure 4 shows the meal input per cow from 1997 to 2006. Meal input varied depending on year, ranging from a high of 835 kg/cow in 1999 to a low of 515 kg/cow in 2004. A drought in 2006 resulted in 695 kg/cow being fed.

A high protein, high cost ration was used in 1997 (costing circa €198/ton). However for the last number of years the ration has comprised a maximum 16% crude protein nut in early lactation, and then either a 3-way mix or straight citrus pulp for the rest of lactation. The average price per tonne is now around €165/tonne.

Figure 4. The meal input (kg/cow) for each year from 1997 to 2006



Focusing on measuring and grass budgeting

In the spring of 2004 the local discussion group decided to focus on grass measurement for the year. The driving force behind this focus was to be able to budget feed to the cows better, which in turn would have the knock on effect of reducing costs and increasing farm profit.

The 'first step' was to start walking the farm each week (with adviser). Two weeks later a clippers, scales and quadrant was purchased. This allowed facilitated testing and training the eye to different covers. At this time the farm was mapped so that the exact area of each paddock was known. These then are the essential tools to grass measuring. After each walk, the data gathered was entered into a notebook or computer, and the average farm cover and cover/cow on the farm was calculated. These figures were then compared with targets discussed in the media or the local discussion group. Recording data eliminates guessing.

By June the bulk of the paddocks were being 'eyeballed', with only a few being cut to keep the eye in tune. Confidence increased weekly. In autumn it was possible to walk the farm without the clippers and estimate the farm cover. The farm walk and budget took approximately one hour. Today with the increased land area, the time taken to do the measurement and budgeting has increased to around 2 hours/week.

By having figures and setting targets, it is possible to plan when to close paddocks in the autumn, when to reduce meal feeding, and have the confidence to graze cows earlier in the spring. The net result is cows spend longer in the field and less time indoors.

Results of measurement

Grass measurement increases the days at grass, allows for tighter grazing and provides information to leave meal feeding in or out depending on growth and demand.

A typical calculation is shown below;

- Paddock 1 = 1.1 ha and has a cover of 1800 kg DM/ha. This means there are 1989 kg DM/ha in the paddock for the cows.
- If 90 cows are allocated 20 kg/cow/day, there is a requirement of 1,800 kg. This means there is enough grass in the paddock for 24 hours, leaving the paddock fully grazed out with 200 kg in the field around dung pads etc.
- If there were 2200 kg in the paddock, there would be 2420 kg available for grazing and surplus grass for the 90 cows. This would require a further grazing or part thereof at some other stage.

The key clincher in the 'KNOW' versus the 'GUESSSING GAME' is that if you know growth rate is 65 kg/day and demand is 62 kg/day, then you know there is enough grass to meet my demand, and that supplement is no longer required.

Demand = stocking rate x grass allowance
= 3.1 cows/ha x 20 kg/cow/day = 62 kg

Subtracting the estimate put on the paddocks each week, or finding out the nearest growth rate to the farm can be used to calculate growth rate. A particularly useful figure is the kg of grass per cow during the main grazing season. A good target is to stay within the range of 180 to 200 kg of grass/cow during the main grazing season. This means there won't be a grass deficit or surplus available to the herd. In many ways this figure is more appropriate than Average Farm Cover as it takes into account different stocking rates and can be used at discussion group meetings to compare between farms.

The bottom line

As a member of the DAIRYMIS discussion group, the costs of production have been recorded for some time. To see what measuring grass has done to profit it is possible to compare the results of the farm pre and post grass measurement. These can be considered in terms of a) cost savings, and b), increased income with higher milk output.

a) Savings in cost
The cost per litre in meal and fertiliser can be analysed for the three years prior to grass budgeting (2001 to 2003) – Period 1, and post grass budgeting (2004 to 2006) - Period 2.

1. In Period 1 meal cost averaged 2.54 c/l compared to 1.67 c/l in Period 2. The corresponding cost for fertiliser averaged 1.64 and 1.32 c/l respectively.

2. Total meal and fertiliser costs averaged 4.18 c/l in Period 1 versus 2.99 c/l in Period 2. This is a reduction of 1.19 c/l between the two Periods.

3. If the milk produced in 2006 (515,290 litres) is multiplied by the above cost reduction, it equates to €6,131/year. 100% of this cost reduction can be attributed to budgeting and measuring grass.

b) Milk output
Looking at milk production statistics for the same periods described above.

1. Milk yield increased from 1187 gallons (5555 kg/cow) for Period 1 to 1315 gallons (6154 kg/cow) for Period 2.

2. Protein percentage increased from 3.31% in Period 1 to 3.39% in Period 2. Fat percentage increased from 3.72% in Period 1 to 3.78% in Period 2.

3. When these figures were input to the Moorepark model, the results suggest that the gain in milk sales was equivalent to €150 per cow. If 50% of this gain is attributable to getting more grazed grass into cows, this means a further €6,750/year increase in milk sales when Period 1 is compared to Period 2.

Adding the cost reductions in meal and fertiliser (€6131) and the increase in output (€6750) gives a total economic benefit of €12881/year to the farm. This financial gain was achieved by spending an hour a week walking, estimating, and budgeting grass is on the farm. If it takes an hour and half to walk the farm each week on average, this is a total of 60 hours in the year, or €215/walk.

Another way of expressing this information is to convert it to €/cow or cent per litre. It works out at €140/cow annual benefit, or 2.5 cent/litre on 515,290 litres (2006) (NB. No consideration is given for a reduced milk price, savings in labour, associated health cost savings, or fixed costs reduction etc. in these simple calculations).

Where can grass measurement and budgeting impact further?

- As cow numbers increase, the benefits in terms of profit (reduced labour etc) become more apparent.

- Knowing there is enough grass in the system makes it much easier to make decisions on a daily basis.
- Research at Moorepark and the grass breeding companies will be required to supply grass that has improved performance with higher dry matters and intake capacity.
- There is a need to be able to select between grass varieties, to identify which is the best grass for the farm and to be able to predict grass growth easier in the future.

Conclusions

Measurements are good but need to be accompanied by budgeting, i.e. having targets for different times of the year and being able to compare where the farm in relation to the targets and take what action when necessary. Measuring and budgeting for one and a half hours per week for 40 weeks of the year = to €215/walk into the 'back pocket', or €140/cow or 2.5 cent/litre. It's free!

Key Points

- Profitable milk production in Ireland is broadly based on the provision of sufficient quantities of high quality pasture to produce quality milk at lowest cost.
- Spring grazing management must focus on efficient use of grass to substitute grass silage and concentrate from the lactating cow's diet. Spring grazing has a large carryover effect on grass quality in subsequent rotations.
- In spring, the first rotation must last until mid-April, excessive pasture damage must be avoided and post-grazing height must be maintained at 4-5 cm to ensure pasture quality is high during subsequent rotations.
- Mid-season management must aim to maximise animal performance while maintaining pasture quality. High pre-grazing yields (>1,800 kg DM/ha) should be avoided. Topping and silage conservation should be used as tools to correct poor pasture quality.
- Large differences exist between grass cultivars, choosing the correct cultivar for the system has a major effect on milk output and profitability of the system.
- Future grass breeding and evaluation needs to focus more on characteristics that influence animal performance under grazing rather than under conservation.
- Grass measurement has a large influence on overall farm profitability and is vital for efficient grassland management.
- Grazing management targets are based on the ability of the manager to competently estimate the amount of grass on the farm and react to make changes in times of surplus or deficits.

Introduction

The Irish dairy industry will experience considerable change in the years ahead. Among the main catalysts of change, reform of EU agricultural policy is anticipated to result in a reduction in dairy product prices paid to dairy farmers (Binfield *et al.*, 2003). The challenge for Irish dairy farmers is to increase the competitiveness of their businesses through increased scale in the long term, but also through increased innovation and efficiency within their current operations. The production and utilisation of grass has a central role in maintaining the competitiveness of the Irish dairy industry. Economic analysis (Shalloo *et al.*, 2004) shows that maximum profitability within Irish milk production systems can only be achieved through the optimum management of pasture both within the current quota regime and within future scenarios where additional quota may become available to Irish dairy farmers. The ability of progressive dairy farmers to maximise the performance of their herds from grazed grass produced within the farm gate will be a significant factor deciding the success of their business in the future.

Dillon *et al.*, (2005) suggest that regardless of country or quota existence, a 10% increase in grazed grass in the feeding system will reduce the cost of milk produced by 2.5 cent/litre. Consequently one strategy to lessen the impact of reduced milk price is to continue to increase the grazed grass proportion of the diet. Irish dairy farmers can reap greater benefits from improved pasture management compared to our main competitors through the uptake of better grassland management techniques.

The objective of this paper is to discuss:

- The evolution of best grazing management practices in recent years
- The potential performance from pasture based on research findings;
- Future grass selection criteria and strategies;
- Guidelines and challenges facing grassland production systems.

Recent trends in grassland management practice

There have been many changes to grassland management in the past decade. Increased emphasis is now placed on technology to extend the grazing season into early spring and late autumn, to reduce the requirements for alternative higher cost feeds. Early turnout (post calving) is now normal practise on many farms and clear benefits have been observed (Dillon *et al.*, 2002; Kennedy *et al.*, 2005). Autumn management has also evolved with higher farm grass covers built to provide a grass supply into November, with some pastures closed to store grass over the winter to have herbage available for spring grazing.

The evolution of management practice within Moorepark since the mid- 1980s is summarised in Table 1. Over the 22 years, mean calving date has been delayed, and stocking rate reduced to facilitate the incorporation of a greater proportion of grazed grass in the diet of the dairy herd. The current grazing season length is 290 days, with the main increase in the number of grazing days realised through earlier spring turnout. The grass growth potential of the sward has increased, achieved mainly through reseeding of older pasture and through the more efficient use of artificial and organic fertilizer. There has been a consistent reduction in the proportion of second cut grass silage taken, due in the main to a longer grazing season.

Due to the extension of the grazing season the feed budget of the dairy cow has also changed – grass allowance has increased by 40% coupled with a 30% decrease in grass silage input, along with a 50% reduction in concentrate allowance. In the future we are likely to see a further increase in the quantity of grass in the overall feed budget.

In the following section the grazing season will be broken down into the spring and main grazing season. Each of the periods will be discussed and the most recent grassland research results will be applied to each section.

Table 1. Changes in the standard Moorepark system (MacCarthy, 1984) and the current Moorepark system for spring milk production (Horan *et al.*, 2004)

	1984	2006	Difference
Mean calving date	2/2	24/2	+22 days
Stocking rate (LU/ha)	2.91	2.5	-0.41
N input (kg N/ha)	423	255	-168kg
Grazing season length (days)	250	290	+40
Turnout by day	10/3	10/2	+27 days
Turnout full time	1/4	10/2	+49 days
Housing date	15/11	25/11	+10 days
Silage area - First cut (%)	43	40	-3
Silage area - Second cut (%)	33	15	-18
Annual animal diet			
Grass (t DM/ cow)	2.8	3.9	+1.1
Silage (t DM/ cow)	1.5	1.0	-0.5
Concentrate (t DM/ cow)	0.75	0.35	-0.4

Benefit of early spring turnout to pasture

In the past 4 years a number of grazing experiments were undertaken in Moorepark to quantify the advantage of supplying a larger proportion of the diet as grazed grass to the spring calved dairy cow in early lactation.

Experiment 1

Over a seven-week period, cows on an Early spring grazing (ESG) system were offered a daily grass allowance of 15 kg DM + 3 kg of concentrate, while cows on an Indoor feeding (IF) system were offered a high concentrate diet of 44% grass silage (8.6 kg DM/cow/day) and 56% concentrate (11.1 kg DM/cow/day). Table 2 shows the milk production/composition and intake of the two groups of cows from February 16 to April 4. There was no difference in milk yield (28.3 vs. 27.3 kg/day) between the two systems but the cows from the ESG system produced milk of lower fat content (38.6 vs. 41.6 g/kg) and higher protein content (33.6 vs. 30.7 g/kg) compared to the cows from the IF system. The cows in both feeding systems achieved similar total DM intakes (measured during the sixth week of the study) at approximately 15.5 kg DM/cow/day; however there were large differences in the composition of the diets. The cows from the ESG system continued to maintain a higher milk protein concentration and higher grass dry matter intake than the cows from the IF system into the months of June and July.

The results of this study highlight the large benefits (both nutritional and financial) of including grazed grass in the diet of spring calving dairy cows in early lactation.

When modelled on a whole farm basis, early grazing will generate an increased profitability of €2.70/cow/day for each extra day at grass, through higher animal performance and/or lower feed cost.

Table 2. The effect of system (Early Spring Grazing; Indoor Feeding) on the milk production characteristics of spring-calving dairy cows in early lactation

	Early spring grazing	Indoor Feeding
Milk yield (kg/day)	28.3	27.3
Milk fat concentration (g/kg)	38.6	41.6
Milk protein concentration (g/kg)	33.6	30.7
SCM yield (kg/day)	26.6	25.9
Live weight (kg)	498.9	517.2
Liveweight gain (kg/day)	+0.20	+0.03
Body condition score	2.9	2.9
Intake (kg DM/cow/day)		
Grass	12.9	-
Silage	-	5.7
Concentrates	2.8	9.6
Total intake	15.7	15.3

Experiment 2

The objective of this study was to establish the milk production responses of spring calving dairy cows in early lactation to daily herbage allowance (>4cm) and concentrate supplementation level. In early February 66 spring calving dairy cows in early lactation were randomly assigned to six treatment groups. The treatment groups included three herbage allowances (13, 16, and 19 kg DM/cow/day >4cm) and two concentrate supplementation levels (0 and 4 kg DM/cow/day). The cows continued on treatment from February 21 to May 8.

The 6 treatments were (on a daily basis):

daily grass allowance (DHA) 13 kg DM/cow plus 0 kg conc. (L0);
DHA 13 kg DM/cow plus 4 kg conc. (L4);
DHA 16 kg DM/cow plus 0 kg conc. (M0);
DHA 16 kg DM/cow plus 4 kg conc. (M4);
DHA 19 kg DM/cow plus 0 kg conc. (H0);
DHA 19 kg DM/cow plus 4 kg conc. (H4)

The average pre-grazing yield was 1900kg DM/ha (>4cm). Mean pre-grazing sward height was 12.1cm, while post grazing sward height was 3.3, 3.7, 4.0, 4.5, 4.7 and 5.2cm, for the L0, L4, M0, M4, H0 and H4 treatments, respectively. The mean grazing area allocation for the low, medium and high daily grass allowance treatments were (13, 16 and 19 kg DM/ha, respectively. These allowances equated to stocking rates of 3.0, 2.6 and 2.2 cows/ha, respectively during the first grazing rotation.

Herds offered both medium and high levels of daily grass allowance (Table 3) had a higher milk yield, protein yield and bodyweight. Concentrate supplementation had a positive effect on milk (28.8 vs. 25.4 kg cow/day), solids corrected milk yield (22.5 vs. 26.3kg cow/day), fat (1022 vs. 1108g/day), protein (835 vs. 942g/day) and lactose yield (1222 vs.1418g/day), lactose content (48.3 vs. 49.3g/kg) and bodyweight (494 vs. 501 kg).

Table 3. The effect of daily herbage allowance and supplementation level on dairy cow milk production in early spring (February 21^{t} – April 10)

	L0	L4	M0	M4	H0	H4
Milk yield (kg)	23.0	28.3	24.7	28.6	25.1	29.2
Fat content (g/kg)	38.3	38.3	38.9	37.7	37.1	36.4
Protein content (g/kg)	31.9	33.2	33.3	33.3	32.9	33.0
Lactose content (g/kg)	47.7	48.7	48.7	47.9	48.8	47.9
Bodyweight (kg)	486	493	494	504	500	517

During the early grazing season (February –April) a balance must be found between feeding the cow adequately to sustain high animal performance and conditioning the sward for the late spring/summer grazing season. In the first rotation allocating a low DHA had no effect on animal production parameters. In subsequent rotations DHA needs to be increased in line with animal feed demand, without compromising the post grazing residuals. The response to concentrate supplementation in early lactation was high and stimulated higher milk production levels for the remainder of lactation.

Experiment 3

The objective of this study was to establish the milk production responses of spring calving dairy cows in early lactation to concentrate supplementation and daily herbage allowance. In early February, 72 spring calving dairy cows in early lactation were randomly assigned to six treatment groups. The treatment groups included two herbage allowances (13 and 16 kg DM/cow/day >4cm) and three concentrate supplementation levels (0, 3 and 6 kg of concentrate supplementation daily). The cows continued on treatment from February 21 to May 8.

The 6 treatments were (on a daily basis);

daily grass allowance (DHA) 13 kg DM/cow plus 0 kg conc. (L0);
DHA 13 kg DM/cow plus 3 kg conc. (L3);
DHA 13 kg DM/cow plus 6 kg conc. (L6);
DHA 16 kg DM/cow plus 0 kg conc. (M0);
DHA 16 kg DM/cow plus 3 kg conc. (M3);
DHA 16 kg DM/cow plus 6 kg conc. (M6).

The average pre-grazing yield was 1300kg DM/ha (>4cm). Mean pre-grazing sward height was 10cm, while post grazing sward height was 3.4, 3.7, 4.0, 4.2, 4.4 and 4.7cm, for the L0, L3, L6, M0, M3 and M6 treatments, respectively. The mean grazing area allocation for the low daily grass allowance (13.0 kg DM/ha) and medium daily grass allowance (16.0 kg DM/ha) groups were 1274 and 1346 m^2/cow/day.

Herbage allowance had a significant effect on milk yield, milk protein yield ($P<0.01$) and milk protein content ($P<0.05$; Table 4). Concentrate allowance increased milk yield, milk protein yield and milk lactose yield as well as solids corrected milk yield ($P<0.001$). A response rate of 0.53kg milk/kg herbage offered was achieved by the H0 group. Compared to other studies the milk response rates achieved in this experiment were low. This may be explained by the high milk performance of the L0 treatment. The results from this data suggest that if dairy cows in early lactation are being offered a large proportion of good quality fresh herbage in the diet, high cow performance can be achieved by offering 3kg concentrate DM/cow/day.

Table 4. The effect of supplementation level and daily herbage allowance on dairy cow milk production in early spring (February 21 – May 8)

	L0	L3	L6	H0	H3	H6
Milk yield (kg)	25.7	27.4	30.5	27.8	29.8	31.6
Fat content (g/kg)	36.6	36.0	36.6	38.0	36.8	36.6
Protein content (g/kg)	32.1	32.6	33.1	33.1	33.6	33.7
Lactose content (g/kg)	46.2	46.5	46.8	45.8	47.0	46.7
Bodyweight (kg)	500	518	513	512	531	525

Experiment 4

In this experiment the benefit of early grazing in spring on grass DM production, sward quality and milk production potential in the late spring early summer period was quantified. Two swards were established, one that was previously grazed once from February 16 until April 4 (*Experiment 1*); the other had not been grazed since the previous October/November. This study commenced on April 12 and continued until July 3 during which four 21-day rotations were completed. The cows were on grass only for the duration of the experiment. Each of the swards were grazed at two stocking rates, 5.5 and 4.5 cows/ha on the early grazed swards, and 5.9 and 5.5 cows/ha on the late grazed swards. The grass intake and milk production results are presented in Table 5.

Table 5. Effect of initial grazing date and stocking rate on milk yield and composition from mid-April to early July

	Early grazed swards		Late grazed swards	
Stocking rate (cows/ha)	5.5	4.5	5.9	5.5
Grass intake (kg DM/cow/day)	16.3	17.5	15.2	16.7
Milk yield (kg/day)	22.7	24.5	20.9	22.4
Fat (%)	3.89	3.78	4.00	3.78
Protein (%)	3.29	3.41	3.21	3.27

The cows on the early grazed swards at a stocking rate of 4.5 cows/ha achieved the highest yield of milk, fat and protein, as well as highest protein content and grass dry matter intake. There was no difference in animal performance between the cows grazing the early and late grazed swards stocked at 5.5 cows/ha, even though the early grazed swards had already been grazed once that spring. The results of the present study suggest that swards grazed early in spring have increased milk production potential, grass DM intake and herbage utilisation in early summer.

<u>Summary</u>

Cows outdoors from mid February offered an 80:20 grazed grass:concentrate diet produced similar milk yield with higher protein yield and content compared to cows offered a 40:60 grass silage:concentrate diet indoors.

- In rotation 1, a daily herbage allowance (DHA) of 13 kg DM/cow/day (with 2 to 4 kg concentrate DM supplementation) allowed high milk production performance.
- In a subsequent experiment there was no significant advantage to increasing concentrate input to >3kg concentrate/cow/day in early lactation.
- From early April, DHA must be increased in line with herd requirement to achieve high animal production performance throughout lactation.
- Early grazed swards have similar grass growth potential compared to later grazed swards, but are capable of sustaining higher milk yields and grass intake in subsequent grazing rotations due to higher sward quality.
- 0.8-1.0t grass DM/cow consumed from turnout until the end of the first rotation should be achievable on farms practising early spring grazing. Grazed grass and concentrate can be the sole feed with such a system.
- Grass silage can be removed from the diet post calving with this type of system.
- When modelled on a whole farm basis, early grazing will generate an increased profitability of €2.70 per cow/day for each extra day at grass. This is achieved from higher animal performance at lower feed cost.
- There are beneficial carryover effects on both sward and animal with early spring grazing.

Main grazing season (May to August)

The objective over this period is to achieve high cow performance from an almost exclusive grass diet. Animals must be supplied with adequate allowances of high quality pasture during the breeding season to achieve good conception rates. In general, grass supply is not restricted on farms from late April onwards with good management. Improvement of pasture quality may therefore offer potential to further advance animal performance from pasture. Current research findings suggest that for each 1-unit increase in OMD, GDMI is increased by 0.20kg. Furthermore a 1 unit OMD increase will allow an increase of 0.24kg milk/cow/day. Many herbage allowance studies have been undertaken both at Moorepark and abroad, showing that increasing herbage allowance above 25kg DM/cow/day results in only small increases (<0.05kg) in animal intake. The aim must be to increase the quality of the grass (increased leaf proportion) allocated rather than the quantity offered.

Monitoring of farm grass cover every 10 to 14 days will assist management by identifying surpluses and deficits early, thereby allowing quicker correction e.g. stocking rates adjusted or supplements introduced. Excessive topping during the main grazing season should be avoided as it is very labour intensive and delays pasture regrowth by up to four days (on average, one round of topping should be sufficient from mid-May to late June). Where topping is carried out, ensure that the pasture is topped to a height of <6 cm. Swards mechanically topped to 6cm in early season support higher milk yields (up to 2 kgs/cow/day) than swards grazed to 9cm when subsequently grazed at a low stocking rate. One option to improve mid-season pasture quality on farms is to alternate paddocks that are first and second cut silage, grazing 'after grass' from first cut silage with the herd and taking second cut silage from poorer quality grazed paddocks.

One of the main avenues of producing milk efficiently in the mid season is through the use of later maturing grass cultivars. In a four-year study at Moorepark (Gowen *et al.*, 2003; O'Donovan *et al.*, 2005), late maturing cultivars Portstewart and Millennium produced on average 187 kg/cow (40 gallons/cow) more milk than their intermediate maturing counterparts. Most of this extra production came from swards which had higher intake potential, better sward quality and utilisation characteristics (Table 6). More recent work at Moorepark can predict when a variety will change from vegetative to reproductive growth based on its maturity date. This information, combined with appropriate cultivars and grazing management, can be used to avoid major deteriorations in sward quality. Similar to previous recommendations the choice of later maturing cultivars would seem the most appropriate for grazing systems given their initiation dates (date when cultivars change from vegetative to reproductive) and reduced re-heading intensity.

Table 6. Effect of heading date and grass ploidy on milk production and grass dry matter intake over a two-year period.

	Intermediate Diploid	Inter Tetraploid	Late Diploid	Late Tetraploid
Milk yield (kg)	24.8	25.2	25.7	26.8
Fat content (g/kg)	37.6	39.2	38.5	37.4
Protein content (g/kg)	33.6	34.9	34.1	33.7
Bodyweight (kg)	580	575	581	584
Grass Intake (kg DM/cow/day)	18.3	18.2	18.1	19.4

Future grass selection criteria and strategies

The parameters which grass breeders select on to-day will determine the nature of the material available for grazing in future years. Plant testing has the capability to drive plant breeding towards specific objectives, by introducing new test parameters or shifting importance from one parameter to another. Changes to the methodology of assessment should continuously be considered in view of new research findings and changes in economic environment. With this in view there is a requirement to now rank grass cultivars with an economic evaluation index. To assign economic values to the traits of importance and let these traits come to the fore in the compilation of a recommended list.

Animal Performance Characteristics

The nutritive value of herbage gives an indication of its potential value to grazing animals, but its feeding value (nutritive value x intake) is of most importance. Grass based systems in the future will be required to achieve higher animal performance from grazed grass over a longer grazing season. This will result in increased importance in characteristics such as high DM intake, maintenance of digestibility during primary growth, high nitrogen use efficiency and high nutritive valve.

Sward structure

Sward structure is an important quality aspect of grass in relation to DM intake. This includes herbage mass, sward surface height, bulk density, tiller density, morphological and botanical composition and textural characteristics such as shear and tensile strength. Differences in sward structural characteristics and subsequent animal performance between grass species are well recognised, but more recently differences have also been found among perennial ryegrass varieties (Gately, 1984; Gowen *et al.*, 2003). Gowen *et al.*, (2003) obtained higher DM intake and milk production from late compared to intermediate maturing perennial ryegrass cultivars when cows were stocked to allow adequate feed allowance. The higher performance with the late maturing perennial ryegrass cultivars was associated with a higher proportion of green leaf in the grazed horizon. Wade *et al.*, (1989) first showed that herbage availability increased when the proportions of green leaf in the lower sward horizon was increased. Peyraud *et al.*, (2004) showed daily allowance of green leaf to be a better predictor of DM intake than daily herbage allowance. In a study currently being carried out at Moorepark, Melle an old outclassed variety, out performed all current newly bred varieties in the production of green leaf during the main growing season. Similarly Melle achieved the lowest extended tiller height and pseudostem height, which are sward characteristics that promote high DM intake. The challenge for the future will be to develop swards through grass breeding that will maintain high DM intake (high leaf swards) while at the same time result in low residual sward height.

Nutritional factors

Assuming optimum herbage allowance and management conditions, feed intake in ruminants is most likely controlled by both physical and physiological factors. Physical factors include the cow's rumen capacity for DM or fibre. Physiological factors include end products of rumen fermentation and intestinal digestion. It is generally believed that as energy density increases and fibre content decreases, physical factors pose less constraint on feed intake and physiological factors become more important. The digestibility of forages and rumen fill are strongly related to the cell wall content and lignification of the cell wall. A perennial ryegrass cultivar with lower cell wall content and higher water soluble carbohydrate (WSC) content will result in a higher digestible DMI and milk production.

Seasonality of DM production

Peak DM production in May/June with little emphasis on early-spring/late-autumn DM production characterised systems of animal production based on a high requirement of conserved grass silage. However in recent years with the advent of earlier grazing in spring and later grazing in the autumn, characteristics such as early spring and late autumn DM production have become much more important, with a reduced requirement for high DM production in May/June. The feed budget in the Moorepark blueprint for efficient milk production in the south of Ireland now consists of approximately 75% grazed grass, 20% grass silage and 5% concentrate. This indicates that characteristics that are important for breeding grass for grazing are much more important than that for silage production. High peak DM production in mid-season may result in sward quality problems, resulting in reduced animal performance i.e. low milk protein content. This was evident in recent years with a large increase in the use of late maturing varieties in preference to both early- and mid-season maturing varieties. In 1998/99 late, intermediate and early maturing varieties comprised of 65%, 30% and 5% of total sales respectively; while in 2004/05 late, intermediate and early maturing varieties comprised of 80%, 20% and <1% of total sales.

Summary

- Grass variety breeding and testing has and will continue to play an important role in enhancing the profitability of Irish grassland farmers.
- Future grass breeding and evaluation needs to focus more on characteristics that influence animal performance under grazing rather than under cutting and conservation.
- Routine measurement of mid-season digestibility should be considered in the Irish evaluation system.
- Sward structure (height, tissue partitioning, degree of re-heading), nutritional characteristics (digestibility, CP, WSC and fibre content) and seasonal productivity (spring, summer and autumn) are important traits to select for.

The Moorepark pasture management system guidelines

For the purposes of describing grassland measurement guidelines, the grazing season can be divided into three critical management periods.

- Autumn/Winter (August 1 to Housing)
- Spring – First Rotation (Turnout to April 15)
- Main grazing season (April 20 to August 1).

For the purposes of making use and putting into practice this section of the paper, every dairy farmer needs to walk their grazing area frequently (at least weekly) and make an estimate of the amount of DM on the farm. This is a skill, and like every skill needs to be developed over time. However the farmers who have developed this skill are now reaping the rewards of sustained progress with efficient grassland management and measurement. Looking to the future, the skill of grassland measurement is crucial for dairy farmers committed to profitable futures in dairying.

Autumn/Winter (late August to December)

This is the start of the grassland season. The aim of this period is to maximise the amount of grass utilised in the period September to December, while at the same time finish the grazing season with the desired farm grass cover. The decisions made on the farm during autumn will have a major impact on the success of the farmer at extending the grazing season into the autumn as well as increasing grass availability next spring and deciding when the herd can be turned out to pasture. It is essential that a grass budget be prepared to set the targets for the amount of grass that is required on the farm from August through to May of the subsequent year.

The farm specific factors requiring consideration when making such decisions at this time of the year include: the stocking rate, growth rates, calving pattern and expected length of the grazing season. As a guide for dairy farmers, Table 7 illustrates key target grass covers for a farm stocked at 2.5 cows/ha, growing 14.5 tons of grass DM/yr, with a mean calving date of February 10, and a grazing season extending from early February until late November. The targets described are based on the entire grazing area being available in late autumn and early spring, with first cut silage taken on 40% of the farm on May 25 from silage ground closed since April 10.

Table 7. Target grass covers for autumn and spring

Date	Stocking rate (LU/ha)	Target average farm cover kg DM/ha	Target cover per cow kg DM/cow	Event
09/08	2.5	848	342	
27/09	2.5	1336	536	Peak cover- demand passes supply
15/10	2.5	1283	517	First paddock closed for winter
15/11	2.5	650	262	Supplement introduced
22/11	2.5	560	224	House by day and night
07/02	2.5	661	264	Cows out to grass by day
14/03	2.6	880	342	Cows out full time
09/05	4.2	990	236	Supply exceeds demand

For those operating under different conditions (stocking rates, growth rates, calving pattern and grazing season lengths), it will be necessary to adjust the feed budgets and target covers. The realisation of these targets may require feed supplementation in years of poor growth or at times of poor grazing conditions. For those operating on calving patterns that are more spread out through February, March and April, or at lower overall stocking rates, an earlier spring turnout date than that shown will be achievable. It will also be possible at lower stocking rates to maintain the herd at grass for a longer period in autumn. The objective of budgeting grass in this manner is to provide adequate grass to the herd, while having sufficient grass to maintain the herd at pasture late into the autumn.

The following key objectives should be used during the Autumn/Winter:

- Rotation length should be increased from 24 days in mid-August to 40 days in mid-September to build the average farm cover.

- Highest average farm cover should be achieved in mid to late September at which point a cover of up to 1400kg DM/ha is manageable. (On wetter soils this target needs to be adjusted downward based on the length of the grazing season.)
- The first paddock stopped for the spring should be closed on October 15, in later regions closing may begin earlier as this will compensate for lower subsequent autumn and spring growth. Isolate some suitable dry paddocks for early grazing. Most of the herbage available for grazing next spring will be that grown once these paddocks have been closed.
- Each 1-day delay in closing from October 10 to December 11 reduces spring herbage mass by 15 kg DM/ha.
- Aim to have at least 60-65% of the farm closed by the end of the first week of November.
- All paddocks should be grazed to a post-grazing residual cover of 200 -300 kg DM/ha during the last rotation to encourage winter tillering.
- Avoid reducing the farm cover below 500 kg/ha in autumn or re-grazing pastures that have been closed.
- Budget for 5-10 kg of over winter growth from the time the farm is completely closed in December once all the above have been completed.

Spring (February to late April)

The provision of early spring grass:

Closing date in the autumn, timing and level of spring nitrogen are the two most important management factors influencing the supply of grass in early spring. Date of initial spring nitrogen application will largely depend on location and soil type. On free draining soils in the south of Ireland initial spring nitrogen application should commence from mid to late January. The optimum date for initial spring nitrogen in the central half of the country is early/mid-February, while in the northern region will be late-February. A recent 3-year study at Moorepark obtained a response of 16 kg DM/kg N in early-March to nitrogen applied in mid January. The initial application should be applied at a rate of 30 kg N/ha, with a second application of 30 to 50 kg N/ha in early March depending on grass requirement. Urea is just as effective as CAN for early grass, with the advantage that it is less prone to leaching and has a lower cost per unit.

The aim at this time is to achieve an equilibrium between maximising the amount of grazed grass in the cows diet while at the same time having a farm grass cover of >950 kg DM/ha by late April. The management factors that will have the largest influence on the quantity of grazed grass consumed/cow over this period are stocking rate, calving pattern, autumn closing cover, silage ground availability and spring nitrogen. With variable spring grass growth rate, weekly monitoring will be required and actions must be taken quickly to achieve targets. Preparing a budget to ration grass supply to the dairy herd during the first rotation will facilitate early grazing. Early grazing is further assisted by grazing a proportion of the silage ground twice (immediately at turnout and again in early April) before closing for silage. During the first rotation, it is desirable that paddocks be grazed out to a target post-grazing height of 4-5cm.

The following key targets should be used during the spring:

- A farm cover >600 kg DM/ha in mid January (with paddocks closed in rotation from mid-October the previous autumn).
- A feed budget (grazing strategy) should be planned and updated regularly to control grass demand (grazing stocking rate and daily herbage allowance) and supply (farm cover and grass growth) throughout the spring period.
- The available grass supply should be budgeted with the first grazing rotation finishing between the April 10 and 20.
- A target post-grazing height of 4.5 cm ensures high grass utilisation.
- Good grazing management practises such as block grazing and a good farm road network will reduce the risk of soil damage during this period.
- Grazing management must be flexible during this period; on/off grazing can be successfully used as a method of reducing soil damage during periods of excessive rainfall.

<u>Main Grazing Season (May to August)</u>
The objective over this period is to achieve high cow performance from almost a complete grass diet. Animals must be supplied with adequate allowances of high quality pasture during the breeding season to achieve good conception rates. In general, grass supply is not restricted on farms from late April onwards with good management.

Grassland management guidelines for this period are;

- Farm grass cover should be maintained at 200 to 220 kg DM/cow on the grazing area during the main grazing season.
- Using normal grass growth rates, a stocking rate of 4.2 cows/ha from mid April to early June is sufficient to adequately feed cows at pasture.
- Pre-grazing yields should be maintained at 1400-1800 kg DM/ha to ensure that post grazing height targets are achieved.
- Where pasture quality is good, post grazing heights of 5 to 5.5 cm are achievable without detriment to animal performance.
- Pastures with high post-grazing residues (>350 kg DM/ha; >7.5 cm post-grazing height) should be topped.
- Avoid grazing excessively low pre-grazing heights, as this will result in inadequate animal intake and reduced animal performance.
- Use grass measurements to identify grass surpluses and deficits.

Where must grazing research go next?

Grass based systems in the future will be required to achieve higher animal performance from grazed grass (measured in terms of milk solids per cow and per hectare) over a longer grazing season. This will increase the importance of characteristics such as high DM intake, maintenance of digestibility during primary growth, high nitrogen use efficiency and high nutritive valve.

Animal production from grazed pasture could be improved through increased use of herbage species or varieties with increased intake and digestibility potential. Traditionally plant breeding objectives were mainly focused on increasing DM yield and pest and disease resistance with little emphasis on factors that effect animal performance and the characteristics of animal production. New varieties are described on the basis of maturity date, total annual yield, ground score, spring growth and autumn growth. However, three of the above characteristics are based solely on DM yield. It is clear that a more descriptive recommended list is required by the industry where more definite measurements are made.

The ability to avail of the increased profitability of pasture-based systems may be curtailed by land costs (both rental and purchase). Access to land at economically feasible prices is crucial to the future success of pasture based dairy systems. High land prices reduce the potential return on investment from our production systems. It is envisaged that the cost of conserved forages will continue to increase due mainly to increases in contractor charges, associated with inflation in labour, energy and machinery costs. The profitability of supplement inclusion will be determined by the milk to concentrate price ratio and the level of additional milk production achieved in response to supplementation. If the market value of the additional milk achieved outweighs the costs of supplement inclusion and pasture utilisation is not compromised, higher supplementation levels will yield greater farm profit. However, if milk price continues to decline, the economic feasibility of concentrate use within the dairy feed budget declines as the marginal benefit of increased milk output is outweighed by the cost of the additional supplementation.

The variability in sward growth rate is one of the factors which results in poor or variable utilisation of herbage produced on-farm, as farmers are unable to manage grazing with precision. By increasing predictability of grass growth and animal requirement, feed budgets can be drawn up with confidence. Taking this further, decision support systems can be designed, based on growth models, describing the interaction between the herbage produced and the animals' intake, and used as a grazing management aid. Long term feed budgeting will entail a yearly feed budget-taking cognisance of total herd feed demand, the grass production potential of the farm and also the requirement for purchased fertilizer and concentrate. The development of reliable easy to use decision support tools will encourage greater reliance on grazed grass and greater connection between researchers, extension advisors and dairy farmers.

Conclusion

There is considerable scope to improve animal performance from grass-based systems. Efficient exploitation of grass by grazing will require the development of grazing systems designed to maximise daily herbage intake/cow while simultaneously maintaining a large quantity of high quality pasture over the grazing season. Grazing systems will not be limited during the two to three months of peak DM production, as high animal performance from pasture will supersede high animal performance per hectare. Daily grass intake will be maximised by adhering to important sward characteristics such as maintaining a high proportion of green leaf within the grazing horizon and allocating an adequate daily herbage allowance. The challenge for the future will be to develop swards through management and grass breeding that will maintain high DM intake while at the same time resulting in low residual sward height. Likewise the cow genotype must be compatible with the system of milk production. The development of reliable easy to use decision support tools that facilitate increased reliance on grazed grass to be used by farmers and extension services will contribute to optimising grazing based systems of milk production.

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Achieving less than 3% calf mortality - a herd health perspective

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Introduction

Calf mortality rates between 1 - 30 % have been reported worldwide. Most recent Irish data show national average calf mortality at approximately 6% (CMMS, 2005), with considerable variation on individual farms. The definition of calf mortality varies between authors and may include abortions and stillborn calves. This paper will focus on the concepts relevant to the reduction of mortality in live-born calves. Commonly, mortality is associated with infectious disease such as diarrhoea and pneumonia. The complete elimination of these calf diseases on farm can rarely be achieved. However, control of mortality in live-born calves should be a major objective in all calf rearing practices. A target of less than 3 - 5% mortality in live-born calves less than one month of age is economically achievable.

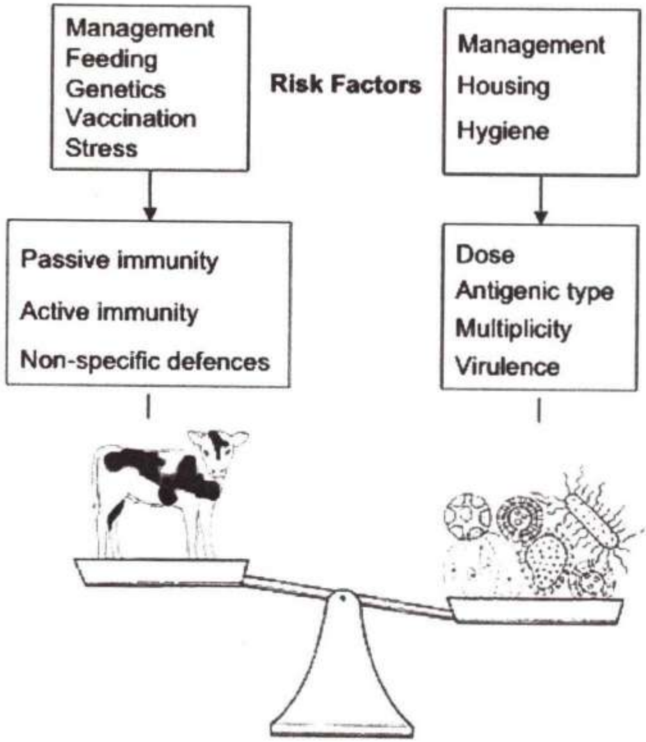
Economic consequences

The economic losses associated with calf mortality stem from the overall cost of calf disease. Apart from the cost of mortality, the direct cost of disease consists of veterinary treatments and farmer time. The indirect costs are associated with reduced growth rates and reduced feed conversion efficiency. Impacts on calf welfare are also of concern to both the farmer and the consumer.

Prevention of disease

Preventing the establishment of disease is based on two key priorities; maximizing calf immunity and minimizing challenge of infection to the calves (see Figure 1). Any preventive program must be carefully structured and has several prerequisites for success.

Figure 1. The establishment of calf disease



Reproduced from Morgan (1990).

Recording and Monitoring

The cornerstone of any preventive program is knowledge of current and future performance. This is only possible through regular farm recording. Recording and monitoring key data such as calf births, deaths and disease episodes and treatments are vital to assessing on farm performance.

Team approach
The farmer should maximize the effectiveness of consultative advise by using a collective team, including their farm advisor and veterinarian, drawing on the various expertise to generate solutions.

Prevention methods

Strategies for the control and prevention of calf mortality can be subdivided into two areas, generalized prevention and problem specific control/prevention.

Generalized prevention
"Generalized prevention" is based on the application of best farming practice. However, this is not universally achievable on all farms, mainly due to economic and labour constraints.

Maximizing immunity
Best practice to prevent calf mortality by maximizing immunity is focused on colostrum feeding management, high quality stockmanship, vaccination regimes, appropriate diet and mineral feeding and general protocols to limit concurrent disease and stress.

Minimizing challenge
Best practice to prevent calf mortality by minimizing challenge is directed at reducing the exposure of calves to potential sources of infection. This is achieved by optimal management of dry cows and the calving area with respect to limiting contact with calves. Calf rearing should be performed to limit mixing of age groups. Vaccination/disease control programs should be put in place to reduce the load of infective agents present on the farm. A high level of stockmanship is required in the management and treatment of sick calves. Housing such as calving pens and calf housing should exceed minimum specifications for dimensions, management and hygiene. Isolation pens should also be available.

Problem-specific control/prevention
Problem-specific control/prevention is based on a structured plan to address an individual farm specific problem, such as neonatal diarrhoea. It is based on a clear understanding of the relevant risk factors at play on an individual farm. In order to achieve this understanding a careful epidemiological investigation of the problem is needed. Having an accurate understanding of the mechanics of the disease on an individual farm allows identification of key risk factors and formulation of economical control strategies.

Investigation

The aim of a problem investigation is to establish the way disease functions on the farm. This is achieved by exploring and understanding the risk areas for the source and spread of infections (Table 1). Clues to the important risk factors are found through analysis of disease patterns using a combination of disease records and clinical history.

Table 1. Risk factors for the source and spread of infection

Risk factors for sources of infection	Risk factors for spread of infection
Environment	Immune status
Calves	Infective load
Cows	

Further investigation such as diagnostic testing should be used to confirm the relevance of various risk factors, e.g. measuring the immune status in calves 1-2 days old to assess colostrum management and passive transfer. The identification of the causal pathogen or pathogens in a specific farm problem is often desired, especially if a vaccination regime is being considered. Care should be given to sample relevant groups and enough samples should be taken to be representative of the group size involved. Often there is benefit in sampling affected and unaffected animals within a group to allow comparisons of significance.

Regarding targeting of farm specific pathogens, careful thought should be given to vaccination strategies. While the aim is to maximise immunity and to reduce disease load on farm, certain management strategies to maximise the benefits of vaccination such as pooling of colostrum may have some potential detrimental effects e.g. Johnes Disease.

Conclusion

Achieving less than 3% calf mortality should be a realistic goal for calf rearing operations. Controlling disease is the key to reducing overall mortality and economic calf rearing. Preventative strategies that do not encompass the farm specific circumstances are unlikely to succeed. An integrated herd health approach allows the application of relevant economic controls and clear mechanisms for monitoring their performance.

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The nitrate directive – getting more out of slurry

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Introduction

Nutrient management and fertiliser planning are receiving much attention at present due to the implementation of the Nitrates Directive in Ireland through SI 378 of 2006 (Anon, 2006). The regulations within this legislation, and the requirements of cross compliance for the single farm payment scheme, are making farmers more aware of the need for more precise planning and utilisation of all fertilisers, both chemical and organic.

In addition to the legal requirements of the nitrates directive, the economics of farming are continuing to emphasize the importance of maximising the return from each input. Fertiliser costs are no exception. For example, nitrogen (N) fertiliser purchased as calcium ammonium nitrate (CAN) increased from a cost of €0.56 per kg N in 1995 to €0.82 per kg N in 2006 (CSO, 2007). This equates to a cost increase over the period of 46%.

In addition to increasing costs, the usage of conventional chemical fertilisers in the future will also be restricted by their availability. This is of particular concern in the case of phosphorus (P), as the world reserves of P are limited in supply (Stewart *et al.*, 2005).

As the usage of chemical fertiliser comes under scrutiny regarding maximum allowances, availability, and cost, the requirement to maximise all available sources of nutrients on the farm is increasing. The management of slurry application to grassland is vital in achieving this. While the fertilisation potential of cattle slurry has always been accepted, the regulations now encourage farmers to maximise both the recovery and the distribution of the nutrients present. This paper outlines how slurry can be used to achieve this.

The nitrates directive

The nitrates directive has had a major impact on slurry management in terms of storage capacity and spreading dates. It also requires that account be taken of the fertilisation potential of the nutrients contained in it. It does this by specifying "maximum fertilisation rates" for N and P. The maximum permitted rates quoted in the regulation do not correspond directly with chemical fertiliser rates, as they must be reduced in order to account for the N and P fertiliser potential of the slurry produced on the farm. (Maximum permitted rates of P must also be adjusted to account for P in concentrate feeds used).

Availability of nutrients in slurry

The fertiliser potential of slurry is calculated based on the percentage of the total nutrient content of the slurry that is deemed to be "available" for plant uptake. Table 1 shows the assumed N & P availability from cattle slurry as specified in the regulation.

Table 1. Nutrient availability from cattle slurry

N Availability %			P Availability %
2007	2008 → 2009	2010 → ?	2007 →
30 %	35 %	40 %	100 %

from SI 378 of 2006

The P contained in cattle slurry is deemed to be 100% available to the crop in the year of application. This closely corresponds to current Teagasc advice. However, N is complicated by the fact that not all the N in slurry is available for plant uptake.

Nitogen availability in 2007 is assumed to be 30%, so a farmer must reduce the amount of fertiliser N that can be used by 30% of the total N contained in slurry. This assumed N recovery will increase to 35% in 2008 and 2009, and increase further to 40% from 2010 onwards.

Since the total fertiliser allowance is fixed for the same period, this assumed increase in slurry N efficiency means that the chemical fertiliser N allowance will be reduced over time. The reduction in any year will depend on the quantity of slurry produced. This is determined by stocking rate and storage period.

Table 2 shows the reduction in fertiliser N required for a farm with a stocking rate of 170 kg Organic N/ha (2 dairy cows per ha) with a slurry storage requirement of 16 weeks.

Table 2. Effect of N availability % on maximum chemical N fertilizer

Maximum N allowed (kg/ha)	2007	2008 → 2009	2010 → ?
Maximum Fertiliser (Chemical + Slurry)	226	226	226
Available N from slurry	16	18	21
Chemical Fertiliser N	210	208	205

Assumptions: Stocking Rate = 170kg Org N/ha; Storage Period = 16 weeks

From table 2, it is clear that the fertiliser allowance would fall from 210kg/ha in 2007 to 205kg/ha in 2010. This reduction on a 50ha farm would correspond to a decrease in fertiliser N on the farm of 250kg – almost equivalent to 1 ton of CAN (27.5% N) fertiliser.

So farmers will have to manage slurry in a manner that maximises the recovery of N, in order to compensate for the reduced fertiliser N input.

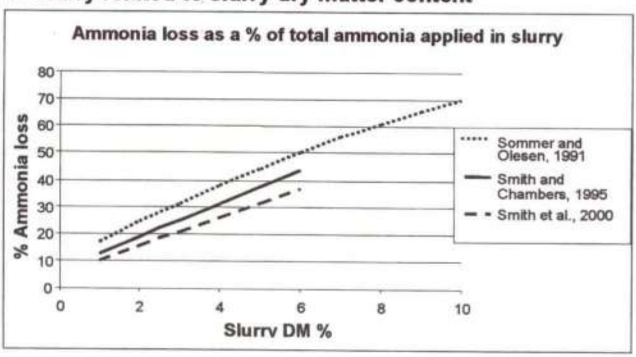
For farms that may not need to apply the maximum amount of chemical N allowed under the regulations, there is still a cost benefit in maximising slurry N utilisation.

Maximising N recovery from cattle slurry on grassland

N content of cattle slurry
Of the total N contained in slurry, approximately 50% is in the form of ammonium (NH_4^+), derived mainly from the urine, and is available for plant uptake. However, ammonium can be also lost to the air. Losses are highest in warm, dry weather. The remaining 50% is mainly derived from the faeces, and is tied up in organic compounds such as undigested feed residues and gut microbes present in the slurry. This N is not readily available for plant uptake, and requires soil nutrient cycling processes to convert it into an available form.

Maximising recovery of slurry N
Minimising the losses of ammonia to the air maximises the fertiliser value. The dry matter content of the slurry will affect the ammonia losses. Slurries with lower dry matter contain more water, and infiltrate the soil quicker. This reduces the time during which the slurry is exposed to the drying effects of the air. Research from Denmark and the UK (see figure 1) has shown that a 1% increase in slurry dry matter content results in an increase in the ammonia losses by between 5 and 8% (Smith and Chambers, 1995; Smith *et al.*, 2000; Sommer and Olesen, 1991). However, having lower dry matter slurries by way of adding water will increase the slurry storage requirements for the farm.

Figure 1. Loss of ammonia to air following surface broadcast (splashplate) application of slurry related to slurry dry matter content



Timing slurry applications to days when the weather conditions are overcast or during mist or very light rain can also help reduce ammonia losses to the air. However, slurry should not be applied when heavy rain is forecast within 48 hours in order to avoid the risk of surface run-off.

Since losses are highest in warmer and drier conditions, applications in the summer after harvesting silage will give rise to higher losses to the air than in springtime. Current Teagasc advice considers N in slurry to be 25% available with spring application (i.e. March/April), but only 5% available in summer (i.e. June/July) (Coulter, 2004). Therefore, applying as much slurry as possible in the spring-time is essential to achieve the N availabilities of 30-40% as laid down in the regulations.

By switching application date from summer to spring, considerable savings can be made in terms of the additional fertiliser required on the farm. Table 3 shows that a farmer can save 22kg/ha of fertiliser N by applying slurry at a rate of 22 t/ha (2000 gallons per acre) in the spring rather than in the summer. If fertiliser is costing €0.82 per kg N, this would result in a potential saving of €18 per hectare.

Table 3. Nitrogen recovery from slurry in spring vs summer application

	Spring Application	Summer Application
Slurry Application Rate	22 t/ha (2000 gallons/acre)	22 t/ha (2000 gallons/acre)
Total N in slurry applied	110 kg/ha	110 kg/ha
Potential N uptake	28kg/ha (25% of total N)	6kg/ha (<5% of total N)

Spring application of slurry

Applying slurry in the summer onto silage stubble is a common practice as soils are often more suitable for trafficking at this time of year than in spring, and risks of contamination affecting subsequent grazing or silage quality are low. While this system is easy to manage, it results in very poor utilisation of slurry N due to high N losses to air.

Spring application is more complicated as grass covers can be high, and opportunities to apply slurry are confined to periods immediately after grazing. This creates two problems. Firstly, rotational grazing results in an uneven sward cover across the whole farm, resulting in a small area at any one time being suitable for slurry application using the conventional splashplate. Secondly, the soil conditions during this narrow spreading window may not be suitable for machinery. Therefore, the splashplate system is often limited for spring application.

Alternative application methods

There are a number of alternative slurry application systems available. The alternative application systems (band-spreader, trailing shoe and injection) are known as 'low emission' spreading techniques. All three systems consist of a boom attached to the back of a tanker on which a number of hoses distribute slurry to the soil surface in narrow lines. Slurry is fed to the hoses via a rotary distribution manifold, which controls the flow of slurry evenly to each hose outlet. Blockages in the pipe-work are minimised by having a slurry chopping capability built into the system. The application of slurry in lines results in a reduced surface area of slurry being exposed to the sun and wind. The potential loss of odour and ammonia to the air is reduced as a result.

The difference between each system is in the manner that the lines of slurry are laid down. The band-spreader deposits slurry on top of the grass canopy, thereby reducing but not eliminating grass contamination. The trailing shoe applies the slurry via a series of "shoe" coulters that deposit the slurry above the soil but below the sward. The effect of the "shoe" is to separate the grass canopy, thereby minimising sward contamination. However, where slurry is being applied to low grass covers, such as silage stubble, the trailing shoe and the band-spreader will produce the same application effect. The injection system deposits the slurry into the soil. This minimises grass contamination, but may cause sward damage and disturbance, particularly in stony soils. The power required to pull an injection system is also higher. The trailing shoe system is viewed as having the most potential as an alternative application system under Irish conditions.

One main advantage that all these systems have over the splashplate is that the reduced ammonia losses from applying slurry in lines should mean that there is more of the N available for crop uptake. This difference is currently being investigated at Teagasc, Johnstown Castle (Lalor and Schulte, 2007). The trailing shoe offers a further advantage, as by applying the slurry below the grass canopy, grass contamination and subsequent ill-effects on grazing preference and silage quality are minimised (Laws and Pain, 2002). This means that slurry can be applied to heavier swards with the trailing shoe, thereby increasing the window of opportunity for application in spring, as application opportunities are no longer restricted to times when grass covers are low and soil conditions are dry enough for machinery traffic. Applications can be delayed if conditions are unsuitable and applied later, when the soil is drier, to heavier grass covers without contaminating the sward. This will result in an extended window of opportunity for application in spring, thus facilitating more efficient N utilisation.

The role of slurry in P recycling

Many farms feeding high levels of concentrate feed inputs now find that very low, or zero, rates of chemical P fertiliser are allowed on the farm under the nitrates regulations. In this case, while the whole farm requirement of P will be met by the P imported in the concentrate feeds, the distribution of this P around the farm will be difficult to manage. The result of this will be that the organic manure produced on the farm will be the only source of P fertiliser that can be managed, as the P deposited by grazing animals is uncontrollable. In this event, farmers will need to return slurry to the areas of the farm with the lowest soil P levels. Since these areas may not coincide with those that traditionally received slurry (silage fields for example), the management of slurry application on the farm may need to be adjusted. This may be particularly difficult where slurry needs to be applied to grazed pastures. In this situation, the trailing shoe may be an option as it would allow greater flexibility for slurry application to pasture, since the grazing rejection would be minimised and slurry could be applied after grazing without affecting grass utilisation in the subsequent grazing.

Potassium and the Nitrates Directive

The nitrates directive does not affect the usage of fertiliser potassium (K). Since a lot of fertiliser K is applied as compound fertilisers that include P, it is important to ensure that a reduced P fertiliser usage does not result in the neglect of grass K requirements. Table 4 shows the K requirement of drystock grazing systems and first cut silage. While fertiliser planning for the nitrates directive includes only N and P, attention should also be given to requirements for K. This is particularly important where slurry application pattern is altered, as cattle slurry is a very good source of K.

Table 4. K requirements (kg/ha) for grazing and first cut silage (values in brackets = units/acre)

	K Requirements (kg/ha)		K supplied by slurry
Soil K Index	Grazing (2 LU/ha)	First Cut Silage	11t/ha (1000 gallons/acre)
1	70 (56)	175 (140)	47 (38)
2	40 (32)	150 (120)	
3	10 (8)	120 (96)	
4	0	0	

Source: Coulter, 2004

Conclusions

The Nitrates Directive is forcing farmers to take account of the available N content of slurry. The proportion of the N that is considered to be available shall increase from 30% in 2007 to 40% in 2010. Farmers must therefore improve the utilisation of slurry N.

The key to achieving high slurry N utilisation is to apply at a time when crop growth and N uptake are high, and when losses of ammonia to the air are low. Spring (March/April) is generally the best time of the year to achieve this.

Spring application should be a priority wherever possible, irrespective of application method. The splashplate application system is a cost effective means of applying slurry, and good slurry N utilisation can be achieved with this method when conditions such as spring application, weather conditions that are overcast or misty, and low slurry dry matter content are met. However, the splashplate system may be limited where dry soil conditions do not coincide with low grass cover. The trailing shoe system applies slurry with minimal contamination, thereby allowing application to taller covers. This facilitates more flexible management as application can be delayed until soil conditions are suitable. This more flexible management may prove particularly useful where slurry distribution across the farm in order to maximise P utilisation is a priority.

While the nitrates directive regulates the usage of N and P fertilisers, farmers still need to consider the requirements of grassland for fertiliser K.

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Feeding and management for easier-care systems

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Background

Located on the Ards Peninsula 30 km south of Belfast, the farm comprises 195 acres (160 owned and a further 35 rented). Land is free draining, with mainly loam soils. Historically rainfall averages 28-30 inches, although this may be changing. Currently the farm enterprises consist of 20 suckler cows, 430 breeding ewes plus 120 ewe lambs, 25 acres of spring barley and 40 acres of short rotation coppiced willow for the production of biomass.

Suckler cows were reduced from 60 in the spring of 2006 with sheep increased to current numbers. The change was based on benchmarking results that showed up the cost of keeping suckler cows post decoupling.

Sheep management

Sheep were first housed on the farm in the early 1980's, as was the fashion at that time to improve the working conditions for both man and beast. Having built a new silo and slatted cattle accommodation, the old silo and adjoining shed was converted to provide removable penning for 240 ewes. The main benefit of housing the sheep was to increase the winter carrying capacity and allow for an increase in sheep numbers. However as we now all know, there are additional costs of indoor wintering: -

- Provision of shelter itself
- Bedding costs
- Need for conserved forage
- Labour for feeding and bedding

By removing the ewe from her natural environment, and the use of more extreme terminal breeds, the need to intervene at lambing time has increased significantly. Indeed it could be argued that flock owners have been selecting for increased lambing difficulty for over 30 years, thereby placing greater demands on labour requirement at this busy time.

Mid-march lambing ewes are typically housed around New Year as 'early lambers' moved out of the main shed. Initially they are fed a silage only diet with access to dry minerals. The aim has been to make the best possible grass silage, with minimum waste. Typical first cut silage analysis is shown in Table 1.

Table 1. First cut silage analysis

Parameter	Value
Dry matter %	21.4
pH	3.7
Ammonia (% total N)	<7
D Value (%)	76
Me (MJ/kg DM)	12.2
Crude protein (%)	15.2

Traditionally two cuts of silage were taken, the first around May 20 (a high quality cut for ewes), and the second in July or August (depending on drought conditions) as a bulk cut for suckler cows. With fewer cattle on the farm, the aim is to take one larger cut in May to provide all the silage needed. This removes the labour requirement to open and close the silo for the second cut, although replacing hundreds of tyres with a woven cover and sand bags has helped reduce labour associated with this task.

A single cut system reduces the cost per tonne of silage made, as the first cut yield is considerably greater than subsequent cuts. Additional savings come from reduced fertiliser use for the remainder of the grazing season. Round bales (x50) are made to buffer feed cows and calves in the autumn, again to reduce cost and labour.

Building layout has been adapted to provide better access for the handler to place silage in front of ewes, with the option to use a feeder wagon in the future. Individual lambing pens have been added with expanded metal to replace straw bedding. The preference would be to have all ewes on expanded metal but cost is currently prohibitive. However, conversion of part of the slatted cattle shed will be completed next year, which will achieve part of this target.

A switch to big square bales of straw 5 years ago greatly reduced the labour requirement around harvest, and all bale handling is now carried out as a sitting down operation. Round bales were too difficult to split for sheep housed in pens, but the move to 1 x 1 x 2.5 m square bales has made splitting possible. The bale is mechanically set onto a home built trolley, which can then be moved easily up and down the house for bedding. Replacing small bales of hay with big square bale haylage, has again eased the labour requirement and any surplus can be sold locally for horses.

Depending on silage quality, concentrate feeding for sheep is introduced about 3 weeks prior to lambing. The home-mixed ration is based on rolled barley and a 36% protein purchased balancer pellet with additional soya and sugar beet pulp shreds. A small amount of molasses is added to reduce dust.

Concentrate is introduced at a low rate and increased, so twin-bearing ewes are on full ration of 0.5 kg per day a week before lambing. Meal is split over morning and evening feeds.

In an effort to reduce the labour required for feeding housed ewes, the farm became involved with a trial organised by AFBI, Hillsborough to examine the potential of replacing a silage and concentrate diet with concentrate augmented by good quality barley straw. This was part of a larger overall programme funded by DARD and AgriSearch looking at key breeding and management options for easier-care systems.

Ewes settled quickly onto the new diet and were more inclined to remain silent and lying down when someone went into the house. The results of the trial, outlined in Table 2, showed that ewes fed high concentrate diets performed equally as well as those on the normal silage plus concentrates regime. However, by taking silage out of the system a considerable saving on labour was realised - especially around lambing time.

Table 2. Comparison of all concentrate and silage plus concentrate diets for pregnant ewes

	Concentrates plus straw	Silage plus concentrates
BCS change	-0.60	-0.55
Lamb birth weight (kg)	5.8	5.8
Lambing difficulty score[a]	1.4	1.5

[a]1 = lambed unaided 5 = caesarean section

Outdoor lambing

Since 1999 a proportion of the flock has lambed outdoors under various treatments for research purposes. Having lambed all ewes indoors for twenty years, this was a daunting prospect, but the ewes quickly adapted to the new system. As experience of the system increased so has confidence, with body condition score better matched to grass cover. Sheep are housed at the normal time on a silage diet and turned out onto grass from two to six weeks before lambing, depending on weather conditions. A low grass cover of 1600 kg DM/ha is sufficient. Regardless of the length of time at grass, there is a consistent increase in birth weight and lamb viability. This system greatly reduces the labour requirement and also provides savings in feeding and bedding. A lot of time is spent moving freshly lambed sheep around indoors which again is greatly reduced outside, particularly with the use of a quad and trailer.

For the past two years the entire flock has been performance-recorded using the

Hillsborough Management Recording Scheme. This involves keeping simple records at lambing (lambing difficulties, birth weight, lamb viability, etc) and at weaning which are used to generate an index for every ewe. Ewes that lamb down without any problems and rear the heaviest lambs to weaning achieve the highest indexes, and vice versa. In 2006 this information was used to select the outdoor lambing ewes for trial. Replacement females were also selected on the basis of their dam's index, and the intention is to continue this process in 2007. Hopefully it should result in a flock of easier managed ewes in the future.

In 2006 about 120 non-trial ewes were selected to lamb outdoors, ensuring they had previous lambing experience, were in reasonable body condition and scanned for twins. The preference is to lamb singles outdoors and multiples indoors as they usually need to be brought in anyway for fostering. However multiple bearing ewes have been turned out to grass during the day in late pregnancy, and housed at night. This management again helped to reduce labour needs of the flock.

Other Management Issues

It is possible to get assistance at lambing time from veterinary students, however all of the other tasks that need to be completed during the rest of the year must also be considered for easier-care systems. Most of these result from the fact that sheep are covered with wool, whether shearing, dipping, treatment for external parasites or dirty back ends leading to fly strike. Perhaps this is a major focus for the future, to have sheep re-upholstered in leather. Selection for resistance to internal worms and dagginess may go some way to solving these time consuming problems.

Experience of on-farm faecal egg counting as an aid to management has been mixed. It is useful to identify the presence of nematodirus and coccidiosis, but differentiation between strongyles and strongyloides has proved difficult. Preference is to collect dung samples which are immediately sent to the AFBI's Veterinary Science Division for professional analysis, and the results returned by email within 24 hours.

The use of footrot vaccine with an annual booster given at housing minimises foot problems associated with straw bedding.

Modern technology, although with a financial cost, offers further opportunity to reduce labour in handling systems. Electronic ear tagging, coupled with automatic readers in weigh crushes and mechanical drafting can provide better data recording and subsequently management with less manpower involved. Some progress to reduce labour input has been made, but there is still a long way to go.

Extended grazing – its potentials and limitations

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Introduction

Ewe numbers peaked in Ireland in 1992 at 4.79 million and have since declined by 39% to 2.93 million in 2006. However sheep production is still an important farm enterprise with output equivalent to €191 million in 2006 accounting for 3.6% of the Gross Agricultural Output. Prior to December 31, 2004, in the subsidy systems of sheep production that prevailed, it was essential to keep ewes to claim the ewe premium. However since decoupling, premia are now received in the form of the Single Farm Payment. In recent years the price received by producers for lamb meat has not improved whilst the cost of production has increased considerably. Furthermore in the "Celtic Tiger" economy an increasing proportion of producers have off farm employment. Currently it is estimated that 48% of sheep producers obtain a second income by working off farm. To maintain margins sheep producers have a number of options including the following. Firstly, increase lamb carcass output per hectare, which is achievable by improving efficiencies within the farm gate. Secondly avail of environmental schemes (e.g. REPS), which previously involved reducing stocking rate and consequently necessitated a reduction in production costs to maintain margins. However it should be noted that in REPS 4, producers will be eligible (even when using high stocking rates within their systems), provided they comply with the Nitrates Directive, consequently doing away with the necessity to reduce stocking rate.

One of the main benefits of the temperate climate that prevails in Ireland is the ability to grow grass for most of the year. The aim of this paper is to present information on increasing the use of grazed grass in sheep production by extended grazing based primarily on recent research studies undertaken at Knockbeg and Athenry.

Herbage for extended grazing

Grass growth in Ireland varies widely throughout the grazing season. Typical grass dry matter growth for March, May, July, October and December is 10, 90, 60, 20 and 5kg/ha/day respectively. Grass dry matter growth of 5kg/ha/day in December, and assuming utilisation rate of 60%, produces adequate forage to maintain only two ewes. Consequently to extend the grazing season between December and March, grass must be 'built up' in late summer/early autumn. The quantity of grass that must be accumulated for extended grazing depends on date of sward closure, level of nitrogen (N) fertilizer applied and date of grazing.

The effects of date of pasture closure and subsequent grazing on herbage yield and proportion of dead material in the sward are presented in Table 1. The earlier the closing date, the higher the yield regardless of grazing date. However it should be noted that regardless of closing date, once the swards reached peak yield, subsequent herbage yield declined. For example, for swards which were closed on July 28, August 9 and August 30, peak yield occurred around November 1, and yield declined subsequently by up to 28%, 23% and 21% respectively. The reduction in yield is due to senescence (leaf decay) exceeding leaf production from November onwards. Date of closure and date of grazing also impact on the proportion of dead material in the sward which is negatively correlated with feed value as determined by digestibility and intake characteristics. Earlier closing together with later grazing increased the proportion of dead herbage in the sward. Thus, for swards which were closed on July 28, August 9, August 30 and September 20, the proportion of dead material on December 1 was 0.51, 0.44, 0.33 and 0.34 respectively, whilst on March 1 the proportion of dead material had increased to 0.79, 0.56, 0.50 and 0.37 respectively (Table 2). Early December and mid March would be considered to be the extremes of the extended grazing season.

Table 1. Effect of autumn closing date on herbage yield and sward morphology at each of five harvests

	Autumn closing date			
	28 July	9 Aug	30 Aug	20 Sep
Herbage dry matter yield (t/ha) on:				
1 October	3.78	1.66	0.84	0.26
1 November	4.10	2.60	1.90	0.70
1 December	3.86	2.28	1.56	0.95
1 February	2.96	1.99	1.50	1.12
1 March	3.12	1.88	1.66	1.05
Proportion of dead material on:				
1 October	0.25	0.18	0.19	0.24
1 November	0.42	0.38	0.31	0.40
1 December	0.51	0.44	0.33	0.34
1 February	0.59	0.50	0.41	0.31
1 March	0.79	0.56	0.50	0.37

(Binnie et al. 2001)

As the date of extended grazing is delayed, the feed value of the herbage declines. The effects of date of grazing of swards closed on September 1 on herbage yield and DMD (dry matter digestibility) are presented in Table 2. As stated earlier, once peak yield was achieved, delaying grazing date reduced herbage yield due to an accumulation of dead herbage. Furthermore, DMD declined significantly in January and February, due primarily to the accumulation of dead herbage and to a lesser extent stem. Consequently the feed value of extended grazed herbage was equivalent to medium and low feed value grass silages after December 7 and January 11 respectively.

Table 2. Effect of date of grazing on herbage yield (above 4cm) and feed value (sward closed on September 1)

	Date of harvest				
	Dec 7	Dec 14	Dec 21	Jan11	Feb 2
Herbage DM yield (t/ha)	2.06	1.86	1.84	1.65	1.50
Proportion of dead material	0.13	0.16	0.21	0.34	0.29
Dry matter digestibility (g/kg DM)	717	706	719	668	611

(O'Riordan, 1995)

The data presented in Tables 1 and 2 clearly illustrate that whilst closing paddocks early for extended grazing increases herbage yield, the proportion of dead herbage increases, leading to a decline in forage feed value. However closing paddocks after mid September substantially reduces the peak herbage yield and as a consequence, requires a greater area of the farm to be closed if adequate herbage is to be available to graze the flock during the conventional winter indoor feeding period. Also, to comply with the Nitrates Directive fertilizer must be applied by September 15. Closing swards early in the autumn subsequently produces open swards due to reduced tiller density. Initiation of new tillers in heavy sward covers in late autumn is inhibited as light is prevented from penetrating the sward canopy to the base of the shoot, consequently carbohydrate reserves are diverted from tiller bud formation to plant respiration.

Year round grazing – the Knockbeg system

Lamb carcass output per ewe and per hectare, and the cost of producing each 1kg of carcass are major factors affecting profit margins from sheep production. Grass, either grazed or conserved, accounts for over 95% of the annual feed budget in mid-season prime lamb production. A major study was undertaken at Knockbeg for four successive years to develop and evaluate a system of mid-season prime lamb production involving year-round grazing, removing the requirement for winter housing and forage conservation. The study consisted of two systems as follows:

A. *Grazing, silage and housing (GSH).* This system involved housing the ewes unshorn and offering grass silage *ad-libitum* for 100 days during the winter. During the conventional grazing season ewes were grazed on grass/clover swards. The mean lambing date was March 20. For the last 6 weeks prior to lambing the ewes received 21.5kg concentrate. Ewes were stocked at 14.1 ewes/ha and annual fertiliser N input was 79kg/ha.

B. *Year round grazing (YRG).* This system involved no housing or forage conservation. The ewes were extended grazed from early December until lambing. During extended grazing the ewes received a grass dry matter allowance of 1kg daily until early February and 1.3kg daily from early February until 2 weeks prior to lambing. Subsequently the ewes were spread out for lambing and received grass *ad-lib* supplemented with concentrate. The mean lambing date was March 30. For the last 6 weeks prior to lambing ewes received

23.1kg concentrate. Ewes were stocked at 10.4 ewes/ha and annual fertiliser N input was 92kg /ha.

In both systems the lambs received creep feed at a rate of 300g/day from 8 weeks until slaughter. Lambs were weaned at 14 weeks of age. The effects of the system on ewe body condition are presented in Table 3. Ewes on both systems had similar body condition at mid pregnancy and at weaning. However the ewes that were housed (unshorn) on the GSH system lost 0.3 of a condition score between mid pregnancy and lambing. The ewes on the YRG system maintained condition from mid pregnancy to lambing, indicating adequate nutrient intake. Other studies have shown that housed unshorn ewes have lower food intake during the housing period due to heat stress. In two years of extended grazing in the YRG system, the ewes were supplemented for a period with 0.4kg/day of sugar beet pulp nuts whilst daily herbage dry matter allowance was reduced by 0.2 kg/ewe, thus increasing total dry matter intake. Supplementation during the extended grazing period was necessary to maintain grass supply for the duration of the season. In one year supplementation in mid pregnancy was equivalent to 15 days extended grazing herbage allowance.

The effects of system on litter size and lamb performance are presented in Table 3. System had no effect on litter size or the numbers of lambs reared per ewe put to the ram. Lambs from the YRG system were 0.7 and 2.9kg heavier at birth and weaning, respectively. Whilst lambs from the YRG had higher birth and weaning weights, and were younger at slaughter, they were marketed at similar dates to those from the GSH system, as they were born later.

Table 3. Effects of system of lamb production on animal performance

	System	
	Conventional	Year round grazing
Stocking rate (ewes/ha)	14.1	10.4
Silage DM requirement (kg/ewe)	100	0
Duration of housing (days)	100	0
Mean lambing date	March 20	March 30
Ewe condition at:		
Mid pregnancy	3.45	3.49
Lambing	3.19	3.40
Weaning	3.22	3.25
Litter size	2.17	2.24
Number of lambs reared/ewe to ram	1.77	1.78
Lamb		
Birth weight (kg)	3.97	4.67
Weaning weight (kg)	27.9	30.8
Growth rate (birth to weaning g/day)	245	267

(Flanagan, 2005)

It can be concluded from the Knockbeg systems study that year round grazing increased lamb birthweight and subsequent lamb performance. However, to facilitate year round grazing stocking rate had to be reduced by 26%, dramatically reducing lamb carcass output by 26%, which is equivalent to 116kg/ha. The system also raised the following issues in relation to extended grazing:

1. What is the feed value of extended grazed herbage?
2. Why does extended grazing increase lamb birth weight?
3. What is the effect of herbage allowance in mid and late pregnancy on subsequent performance?
4. Does frequency of grass allocation affect ewe performance?
5. Is the response in terms of increased lamb birth weight and subsequent performance related to stage of pregnancy at which extended grazing takes place?
6. Can concentrate feeding in late pregnancy be omitted in an extended grazing system?
7. What is the effect of extended grazing on rearing ewe replacements?
8. What is the impact of extended grazing management on subsequent herbage yield?

Each of these issues has been addressed at Athenry and is outlined as follows.

<u>1. What is the feed value of extended grazed herbage?</u>
The big difference between the two systems at Knockbeg was that the year-round grazing system increased lamb birth weight by 0.7kg. Was the increase in lamb birthweight due to extended grazed herbage having a higher feed value relative to silage? The feeding value of extended grazed herbage was evaluated in three studies at Athenry, two relative to grass silage and one relative to concentrate. In terms of lamb weaning weight (which takes into consideration both lamb birth weight and subsequent growth rate) an allowance of 1.3kg of extended grazed herbage dry matter in mid pregnancy had the same feed value as 0.92kg of low and medium feed value grass silages (Table 4). Throughout pregnancy 0.8kg silage DM intake offered to housed shorn ewes had the same feed value as 1.8kg extended grazed herbage allowance (Table 5). For over wintering ewe replacements, an extended grazed herbage dry matter allowance of 1kg had the same feed value as 0.5kg concentrate (Table 6). These data clearly illustrate that the feed value of extended grazed herbage was no better than low or medium feed value grass silage and consequently the improvement in lamb birth and subsequent weaning weights observed in the Knockbeg system study was not due to the feed value of extended grazed herbage. This is in agreement with the data presented previously which clearly illustrated that the proportion of dead herbage in the sward increases (Tables 1 and 2), and DMD declines (Table 2) as the duration of sward closure, and the extended grazing period, increases.

Table 4. The effects of herbage allowance for extended grazing and grass silage feed value in mid pregnancy on animal performance

	Herbage DM allowance (kg/day)		Silage feed value	
	1.0	1.8	Low	Medium
Forage intake (kg DM/day)	0.46	0.65	0.93	0.91
Herbage utilisation (%)	44	34	-	-
Ewe condition at lambing	2.83	3.07	3.14	3.07
Litter size	1.91	1.85	1.84	2.15
Lamb birthweight (kg)	4.47	4.93	4.52	4.51
Lamb growth rate (g/day to weaning)	294	311	312	315
Lamb weaning weight (kg)	33.6	35.6	34.2	34.7

(Keady and Hanrahan, 2007a)

Table 5. The effects of extended grazing throughout pregnancy, shearing at housing and silage feed value on animal performance

	Extended grazing allowance in mid pregnancy		Housed			
			Shorn		Unshorn	
	Low	High	LFVS[1]	MFVS[2]	LFVS	MFVS
Litter size	1.70	1.62	1.77	1.87	1.75	1.93
Birth weight (kg)	4.31	4.48	4.54	4.46	4.08	3.79
Growth rate (g/day to weaning)	295	298	298	299	281	287
Weaning weight (kg)	33.2	33.7	33.8	33.6	31.6	31.8

LFVS[1] = Low feed value silage, LFVS[2] = Medium feed value silage
(Keady and Hanrahan, 2007b)

Table 6. Effects of herbage allowance and concentrate supplementation on the performance of replacement ewe lambs

	Herbage dry matter allowance (kg/day)			
	0.75	0.75	1.25	1.75
Concentrate feed level (kg/day)	0.0	0.5	0.0	0.0
Herbage DM intake (kg /day)	0.61	0.57	0.92	1.24
Herbage utilisation (%)	82	73	73	68
Live weight (kg) at end of:				
extended grazing	35.8	42.2	39.8	42.3
grazing season	52.5	55.8	53.4	56.2
Growth rate during extended grazing (g/day)	-1.0	84	52	84

(Keady and Hanrahan, 2007c)

2. Why does extended grazing increase lamb birth weight?

Winter conditions in Ireland are relatively mild. Consequently, ewes that are housed unshorn may have difficulty in dissipating body heat due to the unique insulating properties of the fleece, leading to ineffective heat regulation and heat stress, particularly in late pregnancy. Ewes managed on extended grazing are less likely to be affected by heat stress relative to housed unshorn ewes. Shearing ewes at housing increases lamb birth weight, relative to housed unshorn ewes, similar to the weight of lambs from ewes extended grazed throughout pregnancy (Tables 5 and 7). Consequently the increased lamb birth weight due to extended grazing is most likely due to reduced heat stress, as evident by the longer gestation length (Table 7) rather than by extended grazed herbage having higher feed value. The data presented in Tables 5 and 7 clearly show that the improvement in lamb birth weight and subsequent growth rate from extended grazed ewes relative to housed unshorn ewes can be achieved indoors by shearing ewes at the point of housing.

Table 7. The effects of extended grazing in mid, late and throughout pregnancy on subsequent lamb performance

	Management in mid and late pregnancy				
	Housed		Extended grazed/ housed	Housed/ extended grazed	Extended grazed
	Unshorn	Shorn			
Litter size	2.25	2.24	2.18	2.10	2.12
Birth weight (kg)	4.2	4.8	4.4	4.5	4.9
Growth rate to weaning (g/day)	288	307	299	303	312
Weaning weight (kg)	32.4	34.8	33.6	34.1	35.2
Gestation length (days)	145.8	147.5	146.6	146.9	147.2

(Keady *et al.*, 2006)

3. What is the effect of herbage allowance in mid and late pregnancy on subsequent performance?

One of the major factors determining the proportion of the farm that needs to be closed in September for extended grazing is the daily grass allowance which will be offered to the ewes in mid and late pregnancy. The effects of herbage allowance offered in mid pregnancy from early December to four weeks prior to lambing on herbage intake and animal performance (Table 4) were evaluated in a study at Athenry. Increasing herbage dry matter allowance by 0.8kg/day increased forage dry matter intake by 0.19kg/ewe daily. However, utilisation rate was reduced from 44 to 34%. Increasing herbage allowance increased ewe condition score by 0.24 units at lambing. Lambs from ewes on the higher grass allowance were heavier at birth (+0.46kg) and at weaning (+2kg) and grew faster from birth to weaning (+17g/day). It was also noted that increasing herbage allowance in mid pregnancy tended to reduce assistance required at lambing. Furthermore, increased herbage allowance resulted in less damage to the paddocks and increased subsequent herbage regrowth (discussed later).

Altering herbage allowance in late pregnancy influences potential concentrate supplementation requirement as well as the area of the farm which must be closed in October, for extended grazing in February and March. The nutrient requirement of the ewe increases dramatically in late pregnancy due to the rapidly growing foetuses. The weight of the foetus increases by 85, 50 and 20% respectively during the last 8, 4 and 2 weeks of pregnancy. During the last six weeks of pregnancy the energy requirements of single and twin bearing ewes increase by 40 and 60%, respectively. The effects of grass allocation in late pregnancy on performance of single and twin bearing ewes are presented in Table 8. With single bearing ewes increasing daily herbage dry matter allowance by 0.3 and 0.4kg/ewe during weeks 4 and 3, and 2 and 1 prior to lambing maintained ewe body condition score and increased lamb birthweight by 0.9kg. With twin bearing ewes, increasing herbage dry matter allowance by 0.2 and 0.7kg/ewe daily respectively during weeks 4 and 3, and 2 and 1 prior to lambing, or supplementing with a total of 8.5kg concentrate prior to lambing, increased lamb birth weight by 0.8kg. Furthermore concentrate supplementation increased ewe condition score by 0.5 of a unit at lambing.

Table 8. Effect of daily grass dry matter allowance (kg/ewe) in late pregnancy on ewe and lamb performance

	Litter size				
Weeks pre lambing	Single		Twin		
6 – 5	1.3	1.5	1.6	1.6	1.6
4 – 3	1.3	1.6	1.6	1.8	1.6 + 200g conc.
2 – 1	1.3	1.7	2.5	3.2	2.5 + 400g conc.
Ewe condition at lambing	3.0	2.9	2.4	2.5	2.9
Lamb birth weight (kg)	4.8	5.7	3.8	4.6	4.6

(Flanagan 2002-unpublished data)

4. <u>Does frequency of grass allocation affect ewe performance?</u>

One of the advantages often quoted for extended grazing is the reduced labour requirement relative to feeding ewes that are housed. Normally herbage is allocated daily, which can be time consuming (particularly for large flocks) as fences (Flexinet) need to be erected ahead of the ewes and the back fences have to be moved. In order to evaluate if labour input can be reduced the effect of frequency of herbage allocation on forage intake and animal performance has been evaluated in recent studies at Athenry (Table 9). In these studies the ewes were extended grazed from mid December to four weeks prior to lambing at which stage they were housed and received a total of 19kg concentrate prior to lambing. During extended grazing the ewes were allocated herbage either daily or twice weekly. Frequency of herbage allocation did not alter forage intake or utilisation. Furthermore frequency of herbage allocation had no effect on lamb birth or weaning weights, or lamb growth rate from birth to weaning.

Table 9. The effects of frequency of herbage allocation in mid pregnancy on herbage utilisation and animal performance

	Frequency of herbage allocation	
	Daily	Twice weekly
Herbage DM allowance (kg/day)	1.4	1.4
Herbage DM intake (kg/day)	0.52	0.60
Herbage utilisation rate (%)	38	41
Ewe condition score at lambing	3.0	2.9
Lamb birth weight (kg)	4.69	4.71
Lamb growth rate (g/day to weaning)	300	304
Weaning weight (kg)	34.4	34.8

(Keady and Hanrahan, 2007a)

The national average weaning rate is about 1.3 lambs per ewe put to the ram. Consequently, most flocks are comprised of ewes that produce only singles and twins. As many sheep producers scan their flocks for litter size in mid pregnancy they can group ewes accordingly. An on-farm study was undertaken by Teagasc to evaluate the effects of allocating herbage daily to single and twin bearing ewes in late pregnancy, either grouped separately (according to litter size) or in a leader-follower system (twin-bearing ewes were leaders followed by the single bearing ewes). The daily herbage dry matter allowances per ewe for weeks 7 to 6, 5 to 4, 3 to 2 and prior to "spread out" for lambing were as follows: 1.3, 1.4, 1.6 and 1.6kg for single bearing ewes grazed separately; 1.4, 1.6, 1.9 and 2.7 for twin bearing ewes grazed separately; 2.7, 3.0, 3.5 and 4.3 for the twin bearing ewes followed by single bearing ewes in the leader-follower system. Allocating grass daily to the single- and twin-bearing ewes separately or in the leader-follower system did not affect lamb birth weight, lambing assistance, growth rate or weaning weight (Table 10). However single bearing ewes in the leader-follower system had a lower condition score at lambing. The leader-follower system reduced labour requirements by decreasing the number of fences required by 50% in a flock of predominantly single and twin bearing ewes.

Table 10. Effect of grass allocation management in late pregnancy on animal performance

	Grassland system			
	Leader-follower		Separate	
Litter size	twin	single	twin	single
Ewe condition at lambing	3.12	2.93	3.00	2.93
Lamb birth weight (kg)	4.95	5.80	4.80	5.97
Lamb growth rate (g/day)	228	269	224	266
Weaning weight (kg)	27.6	32.4	27.1	32.4

(Keady and Hanrahan, 2007d)

5. Is the response in terms of increased lamb birth weight and subsequent performance related to stage of pregnancy in which extended grazing takes place?

On many sheep units where extended grazing is practiced, there is only sufficient herbage available for part of the extended grazing season. Consequently, many producers ask whether they should extend graze ewes either in mid or late pregnancy. A study was undertaken in which ewes were either housed for mid, late or throughout pregnancy, and extended grazed in either mid, late or throughout pregnancy (Table 7). Ewes that were housed and extended grazed received 19 and 15kg concentrate/head daily during the last six weeks prior to lambing. Relative to housed unshorn ewes extended grazing in mid, late or throughout pregnancy increased lamb weight by 0.1, 0.3 and 0.7kg and increased weaning weight by 1.2, 1.7 and 2.8kg, respectively. Consequently, if only limited grass supplies are available for extended grazing, extended grazing in late pregnancy gives the greater response in terms of lamb birth and weaning weights relative to extending grazing in mid pregnancy.

6. Can concentrate feeding in late pregnancy be omitted in an extended grazing system?

In extended grazing, omitting concentrate supplementation reduces feed cost whilst also increasing grazed grass requirements, which subsequently puts pressure on the stock carrying capacity (stocking rate) of the system. A study undertaken at Knockbeg (Table 8) evaluated the effect of grass allowance in late pregnancy on single- and twin-bearing ewes. Increasing herbage allowance of single-bearing ewes during the last six weeks prior to lambing increased lamb birth weight. Furthermore, increasing herbage allowance to twin bearing ewes increased lamb birth weight whilst maintaining ewe condition score. When assessed by lamb birth weight, each 1kg concentrate supplementation in late pregnancy had the same feed value as 1.5kg herbage dry matter allowance. Concentrate supplementation also increased ewe condition score by 0.4 of a unit. In an on-farm study undertaken by Teagasc in which the ewes were turned out to pasture in late pregnancy, single and twin-bearing ewes produced heavy lambs (5.9 and 4.9kg birth weight, respectively) in the absence of concentrate supplementation (Table 6).

7. What is the effect of extended grazing when rearing ewe replacements?

Rearing ewe replacements is a major cost in lamb production. Reducing the cost of rearing replacements by €20/head, either by reducing the replacement rate or feed cost, is equivalent to 18.5c/kg of lamb carcass produced by the ewe during her life time production cycle. An on-farm study was undertaken by Teagasc in 2006 to evaluate the effects of grass allowance and concentrate supplementation on ewe lamb performance during extended grazing and the subsequent grazing season (Table 6). Increasing herbage allowance increased growth rate during extended grazing by 85g/day. When assessed by ewe replacement weight at the end of the extended grazing season, offering 0.5kg concentrate daily had the same feed value as increasing herbage dry matter allowance by 1kg daily. Even when assessed by the weight of the replacement ewes in mid August, 0.5kg concentrate during the previous extended grazing season had the same feed value as 0.9kg of extended grazed herbage dry matter allowance.

8. What is the impact of extended grazing management on subsequent herbage yield?

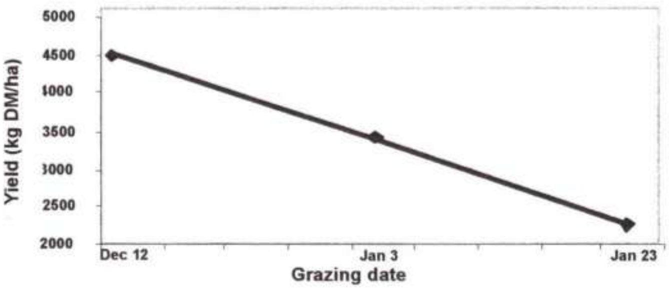
In an all year round grazing system, grass supply will be most limiting in autumn. Grass supply is also a major concern for the first two months after lambing. Consequently, the effects of extended grazing management on herbage yield during the early part of the subsequent grazing season impacts on potential stocking rate. The effect of extended grazing management on herbage yield early during the subsequent grazing season was evaluated at Athenry. In that study, swards were grazed either between December 6 and 12, December 27 and January 3, or January 17 and 23. During each grazing period ewes were allocated herbage dry matter at either 1.0 or 1.8kg/ewe/day and the allocation was made either daily or twice weekly. Increasing daily herbage dry matter allowance from 1.0 to 1.8kg/ewe at grazing increased subsequent herbage dry matter yield by 1.14t/ha (Table 11). Frequency of herbage allocation during extended grazing did not affect subsequent herbage yield (Table 11). However, each 1-day delay in grazing date reduced herbage dry matter yield by 54.2kg/ha (Figure 1), which is equivalent to 18 ewe grazing days. The data from this study clearly illustrated that delayed grazing had a major effect on subsequent herbage yield. A subsequent study undertaken at Athenry in 2007 showed that, in extended grazed pastures that had been grazed between mid December and late January, grazing date and herbage allocation at grazing had a big impact on pasture damage. When assessed in early April the percentage of the sward which was categorised as bare ground varied from 3 to 22% for pastures grazed at high (1.8kg/ewe daily) and low (1.0kg/ewe daily) herbage dry matter allowances the previous winter. However by mid May the percentage of bare ground was reduced to 5.5 and 8.8%, respectively.

Table 11. Effects of extended grazing management of autumn saved pasture on dry matter yield in spring

	Herbage DM allowance (kg/day)		Frequency of allocation	
	1.0	1.8	Daily	Twice weekly
Dry matter yield (t/ha)	2.79	3.93	3.24	3.43

(Keady and Hanrahan, 2007e)

Figure 1. The effects of grazing date on herbage yield early during the subsequent season



Potentials of extended grazing

Extended grazing offers a number of "attractions" for mid season prime lamb production as follows:

a. A sheep production system can be established without the need for winter housing and specialised feeding facilities as the ewes are at pasture year round. As a consequence, fixed costs are reduced substantially. However to comply with the Nitrates Directive adequate slurry and/or farmyard manure storage facilities for a 6 week period are required.

b. Year round grazing facilitates the management of 'flying flocks' and thus the opportunity to enter sheep production when lamb prices are high and exit rapidly at low cost for a number of seasons when lamb prices are low.

c. The cost of producing each 1kg of lamb carcass is reduced due to a reduction in fixed costs. However, some herbage needs to be harvested to control grass growth and maintain grass quality for the grazing flock. Whilst the gross margin per ewe is increased, gross margin per hectare (a key measure of profitability) is reduced.

d. Lambing ewes at pasture reduces labour requirement, particularly in flocks predominantly of single and twin bearing ewes, as ewes only need to be moved short distances to paddocks and lambing pens are not required. However, ewes that need to be handled are more difficult to capture.

e. Extended grazing provides a cheap system for rearing replacements, particularly where pasture is allocated twice weekly rather than daily.

f. Extended grazing can represent an alternative system for producers that operate at a low stocking rate.

Limitations of extended grazing systems

Whilst year round grazing has potentials, it also has various limitations. These are as follows:

- Stocking rate is limited to a maximum of around 10 ewes/ha, consequently reducing potential lamb carcass output by up to 26%. In year-round grazing the grass requirements peak in September due to the following; a) approximately 50% of the grazing area needs to be closed in September and early October to accumulate grass for grazing from mid December to lambing in early April; b) ewes need to be prepared for mating which impacts on the next lamb crop (previous studies at Athenry have shown that each one unit increase in condition score at mating increases weaning rate by 0.1 lambs/ewe put to the ram); c) any lambs remaining in September and October require high quality pasture to finish.
- Year round grazing is an inefficient system for utilising herbage. As discussed previously, during extended grazing up to 28% of accumulated herbage may be lost, utilisation of remaining herbage may be as low as 40% and feed value declines steadily (due to senescence of leaf being greater than green leaf production) during the extended grazing period.
- There is evidence to show that herbage management during extended grazing impacts on sward quality. Recent studies at Athenry have shown that in the April and May, following extended grazing the proportion of the sward categorised as "bare ground" was as high as 22 %.
- The success of extended grazing is very dependent on weather and ground conditions. For example at Athenry and Oakpark mean annual rainfall during the last 30 years was 1162 and 789 mm, respectively. This difference can have a major impact on herbage utilisation and potential sward damage.
- Good grassland management is essential in early summer in a year-round-grazing system, as grass availability will exceed demand. Consequently paddocks need to be removed for ensiling. Furthermore there is evidence from the Knockbeg systems study that from weeks 10-14, lamb growth rate was similar for lambs from the YRG and GSH systems with growth rates of 220 and 228g/day respectively. Consequently the potential benefit of the higher lamb birth weight on age at slaughter is not fully exploited.
- Even at a low stocking rate (10 ewes/ha) strategic concentrate supplementation (equivalent to approximately 2 weeks herbage supply) was required in Knockbeg to ration herbage supply for extended grazing in two out of four seasons.
- With outdoor lambing, lambing date is delayed in order to reduce the risk of severe weather. Consequently most of the major annual price falls for lamb carcass have occurred prior to the lambs being drafted for sale.
- On a 50ha farm, year round grazing reduces gross margin by up to €10,150.

Other considerations

- Currently 48% of sheep producers have an off-farm income. Consequently, during the winter, having the ewes housed may be more suitable for part-time farmers, as they can be fed at night. Using modern equipment, during the housing period, large numbers of sheep can be fed in a short period of time.
- Whilst extending grazing ewes throughout pregnancy increases lamb birth weight relative to lambs from unshorn housed ewes, lambs from shorn housed ewes are of a similar weight at birth, weaning and age at slaughter. Consequently, the benefits in lamb performance from extended grazing can be obtained indoors by shearing the ewes at housing.
- With the new proposed REPS 4 scheme, intensive systems of lamb production comply (provided they comply with the Nitrates Directive), consequently there is no need to reduce stocking rate, as is required for year round grazing.

Financial analysis of the systems

Calculations designed to show the effect of system of mid season prime lamb production on income, costs and margins (excluding labour and machinery costs), based on the Knockbeg systems study are presented in Table 12. Lamb carcass weight and price were assumed to be 19.5kg and €3.50/kg respectively. Concentrate was costed at €240/tonne. Silage was harvested using the big bale system. In costing sheep housing, it was assumed that a 50% grant was available and that depreciation was over a 30-year period. In the year round grazing system, excess herbage was ensiled and sold as big bale silage.

Margins per ewe were higher on the year-round grazing system. However, margin per hectare, which is the major factor affecting income, was higher for the grass-silage-housing system. The grass-silage-housing system increased gross margin by €203/ha. On a 50ha farm, year round grazing decreased gross margin by €10,150/annum. As lamb price increases, the difference in gross margin per hectare between the two systems increases in favour of the grass-silage-housing system relative to the year-round-grazing system.

Table 12. Example of income, costs and margins from the systems per ewe*

	System	
	Year round grazing	Grass silage housing
Income (€/ewe)		
Lamb carcass (€3.50/kg)	121.1	121.1
Wool	2.2	2.2
Silage (8 bales/ha)	12.0	-
Replacement cost	-13	-13
Variable costs (€/ewe)		
Fertiliser	6.4	4.1
Concentrate	14.6	13.0
Shearing	2.5	2.5
Veterinary	8.1	8.1
Miscellaneous	4.0	4.0
Silage harvesting	8.0	6.4
Gross margin (€)		
per ewe	78.6	72.3
per ha	817	1020
Gross margin per ha at lamb carcass price of		
€3.70/kg	889	1117
€3.90/kg	961	1215
€4.10/kg	1033	1313
Other costs (€/ewe)		
Flexinet and fencer	1.2	-
Housing (includes 50% grant)	-	3.5
Gross margin (including wintering costs)		
per ewe	77.4	68.9
per ha	805	972

*based on the information and performance recorded at Knockbeg

Conclusions

It is concluded that an effective year round grazing system can be practiced successfully. However stocking rate is reduced significantly, dramatically reducing lamb carcass output/ha and gross margin/ha. However to comply with the Nitrates Directive adequate slurry and/or farmyard manure storage facilities for a 6 week period is required. Extended grazing;

a. increases lamb birth weight relative to lambs from housed unshorn ewes;
b. limits stocking rate to a maximum of 10 ewes/ha;
c. requires excellent grassland management to be successful;
d. provides a low cost system, particularly for 'flying flocks',
e. is a relatively inefficient system of utilising herbage.

Allocating herbage twice weekly rather than daily has no effect on animal performance or subsequent herbage growth, but concentrate supplementation is still required to enable the year round grazing system to succeed. The improvement in lamb birth and weaning weights due to extended grazing can be achieved indoors by shearing ewes at housing. On a 50ha farm year round grazing reduces gross margin by up to €10,150.

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Breeding for easier care

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Introduction

The farm comprises approximately 550 acres at Harphall in the southern Glens of Antrim. It is a hill farm rising from 50 feet above sea level to about 1200 feet, the land varies from heavy clays through red mineral soils to blanket peat on the hill. The farm stock comprises 500 breeding ewes, 120 dry hoggets with suckler cows grazed in the summer.

The foundations of the sheep flock are Blackface ewes with about 180 bred pure to provide replacements both for themselves and for the crossing flock of 120 ewes, which are crossed to Texel, Lleyn or Colbred rams. These provide the replacements for the flock of 200 crossbred ewes, which are crossed with Suffolk or Texel rams. Any suitable surplus ewe lambs are sold for breeding, and the rest along with the wethers are mostly sold finished, although depending on trade some may be sold as stores. A few Blackface ram lambs are also used for breeding at home before being sold as shearlings.

Signet recording scheme

The pure Blackface ewes have been recorded through the MLC/Signet sheep breeder service since 1997, and since 2002 the farm has been a member of the Sire Reference Scheme that allows for direct performance comparisons between different flocks in the scheme. Last year the Blackface breed moved to across breed analysis, which allows direct comparison of sheep across all recording flocks in Britain and Ireland. This will hopefully allow for the identification of the best genetics within the breed, and speed up progress.

The Signet scheme produces seven Estimated Breeding Values (EBVs) based not only on the animals' own performance, but also on the performance of all its recorded relatives within the scheme (Table 1). These seven traits are used to produce an overall index, which is a quick guide to an animals breeding potential.

Initially the scheme was only used to maintain the size and conformation of the Blackface flock, probably not enough attention was paid to maternal traits. However, as information on the ewes built up, it became clear that ewes that were giving problems at lambing, and rearing poorer lambs, almost invariably had lower EBVs for maternal and 8-week weights. Consequently, today when selecting new stock rams individual EBVs are used rather than just the index, placing particular emphasis on maternal, 8-week weight and scan weight, whilst keeping muscle depth and litter size above breed average. On this farm it is generally felt that the ewes are big enough, and so no attempt is made to increase mature ewe size any further, although this tends to happen naturally with higher scan weights. As long as growth traits are good, there is no problem with slightly positive fat depths as the ewes will need to retain body condition over winter, and considering the current price of concentrates, the last thing that is wanted is big lean lambs which will have to be pumped full of meal to finish.

Table 1. Outline of Estimated Breeding Values (EBVs)

EBV	Brief Explanation.
Eight-week weight	Potential growth from birth to 8 weeks of age.
Mature size	High figures will increase mature size.
Litter size	Potential to increase prolificacy of female replacements.
Maternal ability	Higher figures indicate better maternal traits of daughters (i.e. better milkers and mothers).
Scan weight	Potential growth to scanning at 20 weeks old. Higher figures will result in heavier carcasses at the same fat class.
Muscle depth	Measured by ultrasound scanning. Higher figures indicate deeper loin muscle.
Fat depth	Lower or negative figures indicate lower fat levels, and leaner animals.

Hillsborough recording scheme

Since it became available in 2005 the farm has been using the Hillsborough Recording Scheme for crossing Blackface ewes. These are used primarily to produce crossbred replacements, and would be mainly lower index or ewes that don't conform as well to breed type. It is a simple scheme, which requires only a little time and effort from the farmer. At birth the lambs are tagged and the parentage recorded along with a simple tick box score for lambing difficulty and milking and mothering ability. The books are returned to Hillsborough, and that is it for recording until weaning time, unless a ewe has a particular problem such as mastitis or footrot which can be noted in the book. At weaning the lambs are weighed and from this information a list of ewe lambs ranked in order of their suitability as replacements is produced. The final choice is still down to the farmer, but knowing that a lamb's dam had an awful lambing, and was a lousy mother can make such decisions a lot easier.

Benefits of recording

Is it all worth it? The question is often asked, "Where is the time for all that recording?" The answer is – "Where is the time to lamb a flock of ewes which haven't been recorded? All sheep farms will have ewes which get on with the job of producing two good lambs without help and making a decent job of rearing them year after year, and equally there are plenty of ewes which give hassle, have little colostrum and don't want to know about their lambs. There is no doubt as to which one should be kept for a replacement, but if there is no recording can you really be sure that that flashy looking ewe lamb isn't a big single that you hauled out of the ewe at 03.00 one morning, and that it's not from a long line of flashy looking but lousy mothers? Recording for easier care traits is certainly a long-term strategy, but it is amazing how quickly progress can be made, just by identifying and culling problem ewes from the flock. This progress is cumulative; so long as you are using recorded tups to breed replacements each generation should be superior to the last.

On this farm we have certainly seen the benefits. Adopter crates are things of the past, and in the last three years only one ewe rejected her own lamb, (needless to say she is no longer with us). In 2007 the farm turned out a batch of 97 Blackface ewes with twins, 194 lambs, and at 8 weeks old weighed 192 of them. They were checked once a day for tetany in the ewes, but otherwise were left to get on with it, which they did. The aim now is to breed a ewe which is "Fit for Purpose" rather than one which looks pretty.

Future developments

So what does the future hold? There are a number of new developments becoming available to sheep farmers. Faecal egg count EBVs are already available to measure worm resistance, the Blackface sire reference group are investigating EBVs for longevity and what information we need to record to measure lamb survivability. The increasing use of DNA technology means that all these together with a simple test for footrot resistance could soon be available, but in order to benefit from all this technology sheep farmers, and specially breeders, must get involved in the uptake of recording schemes. Whether it is something as simple as ear notching ewe lambs out of good mothers through to getting involved in sire referencing schemes, the ethos of breeding for easier care is straightforward. It is to record and cull problems for an easier future.

Management of the hill sheep flock at Leenane

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Introduction

The purpose of this paper is to outline the performance of the ewe flock at the Teagasc hill farm with particular emphasis on management inputs around mating and lambing as an example of the performance that can be achieved in terms of ewe and lamb survival without round-the-clock supervision during the lambing season.

Farm facilities and production system

The Teagasc Hill Sheep Farm is located in the Sheffry hills near Leenane and consists of 250ha of hill land and 20ha of reclaimed green-land. The farm varies in altitude from 15 to 275m above sea level and average rainfall at the farm was 2124 mm for the 10 years 1995 to 2005. The green-land area was re-seeded in 1991/92 and the swards are mainly ryegrass; it is possible to cut silage from about half this area.

There is a stock-proof perimeter fence and the green land is fenced into 10 paddocks – mostly sheep wire but has electric fence around the main lambing paddocks. There is a slatted shed that can accommodate 200 ewes. The handling facility is built along side a 3-bay hayshed with the race and weighing scales under the shed roof; the hayshed also provides storage for equipment (fertiliser spreader, topper and sprayer etc.). There is also a small tractor, trailer and transport box, livestock trailer and block cutter on the farm.

The flock consists of about 340 Scottish Blackface (local type) ewes and about 80 homebred replacements. The ewes are managed as two integrated systems:-

- **Hill system** (200 ewes) - ewes spend about 70% of the year on the hill and have use of 5.6ha of green-land for mating, lambing and for ewes with singles males to weaning. Wether lambs are sold to export market for light lamb.
- **Lowland system** (140 ewes) - ewes spend about 30% of the year on the hill and have use of 14.4ha of green-land for mating and from lambing to weaning. Lambs remain on green land until sale or indoors for finishing from early October.

Replacement ewes are housed (on silage with concentrate supplement) from mid November to late April and spend the rest of the year on the hill. The ewes in the Hill system are bred pure (to generate flock replacements) while the ewes in the Lowland system are crossed (usually with Belclare rams) to produce prolific ewe replacements for sale. Ewes spend their first three breeding seasons in the hill system and are then transferred to the Lowland system where they remain until they have to be culled.

Ewes are checked for breeding soundness (teeth, udder, feet) at weaning and those that are to be culled are identified; cull ewes are sold at an appropriate stage between weaning and late September. Broken mouth is the principal culling reason.

Management of ewe flocks

All ewes are on the hill grazing from weaning until just before joining - with the exception of a small number of ewes in poor condition that are removed from the hill earlier. Between weaning and mating, the lamb crop grazes the green-land. Crossbred wether lambs are sold to slaughter at French weights; purebred wethers go to the light lamb market; crossbred females are sold off the farm in early September. In early October all remaining lambs are housed (for finishing) to ensure that sufficient grass is on the paddocks for the mating period. The mating system involves single ram groups for both Hill (5 rams) and Lowland (5 rams) systems so that sire and dam are known for every lamb. Ewes are put to ram in late October for the Lowland system and in the third week of November for the Hill system. The joining period is 35 days in both cases; rams are fitted with crayons and ewes mated within the first 10 days get a permanent colour mark to facilitate introduction to concentrate feed 10 days before the remainder of the flock and so that they can be put to grass before the rest of the flock (Lowland system) - thus making best use of the scarce grass supply at lambing time. The paddocks on the green-land area are used for mating and when rams are removed all ewes are put to the hill until early January (Lowland system) or early February (Hill system). The management of the two flocks differs from this point until lambing. All ewes are scanned in mid-pregnancy to identify twin-bearing ewes.

<u>Lowland flock</u>
Ewes in the Lowland flock are housed in a slatted shed in early January and offered silage *ad libitum*. Ewes with twins (about 50%) are separated into early and late lambing groups and are offered a proprietary ewe-and-lamb ration (18% crude protein) starting at 225g per day at week 7 prior to the expected lambing date. The allowance is gradually increased to 700g per day before lambing. Single-bearing ewes are also separated into early and late groups and get 225g per day increasing to 450g per day for the final week before lambing. Ewes are put to pasture just prior to their expected lambing date (based on early or late mating). Concentrate supplementation is continued outdoors, on a flock basis, using the daily allowance for singles. As ewes lamb they are drafted from the lambing paddock and get no further concentrates.

<u>Hill flock</u>
All twin-bearing ewes from the Hill flock (about 10%) along with any thin ewes (condition score 2 or less) are drafted at scanning onto an enclosed area of the hill (4 ha) and get hay *ad libitum* plus concentrates – starting at 230g per ewe per day and increasing gradually to 454g at 3 weeks prior to onset of lambing. The remainder of the ewes are returned to the hill, and body condition is checked every 3 weeks; any thin ewes are drafted to the enclosed hill area for supplementary feeding. Ewes drafted for supplementary feeding remain in the enclosed hill paddock until they

lamb. About 50% of the Hill flock ewes are off the hill by the third week of March (3 weeks prior to start of lambing); the remainder stay on the hill until just prior to lambing when they are moved onto a paddock in the green-land area for lambing and get concentrates (450g/day) until they lamb. All ewes are drafted from the lambing areas as they lamb. Ewes with twins or male singles are drafted to the same paddock while ewes with female singles are drafted to a separate paddock.

Lambing supervision

From the onset of lambing the first daily inspection is at 6:30 AM - this is the most important inspection of the day as any problems that have arisen during the night are identified. Newborn lambs that have bonded with their dam and are suckling satisfactorily are drafted, during late morning, to a nearby yard area. Immediately before entering the yard, lambs' navels are sprayed with iodine solution, then they are tagged, weighed and sexed, the mother's tag number is also recorded along with her condition score and weight. All dead born lambs are weighed and details recorded. Udders are checked carefully for sufficient milk supply and mastitis before moving animals to the grazing paddock. Ewes are checked ~ hourly during the day until around 4.30 PM; checking is done again between 6.30 PM and 8 or 9 PM, depending on daylight. There is nobody on the farm between the last check and 6.30 AM. Records show that 40% of lambs are born during this period.

Ewe performance

Details on the performance of the two systems are summarised in Table 1, for the 5 years to 2006. The proportion of ewes that lambed was 92% for both flocks. This is considered satisfactory given that single-sire mating groups are used and joining is limited to 35 days. A figure around 95% would be expected under conventional mating conditions.

Table 1. Summary of ewe performance for 2002 – 2006

	Hill system	Lowland system
Ewe live weight (kg)	42.5	51.5
Percent ewes lambed	92	92
Litter size	1.11	1.55
Lambs reared per ewe to ram	0.98	1.36
Lamb mortality (total) (%)	4.9	6.1
Annual ewe mortality (%)	2.5	4.8

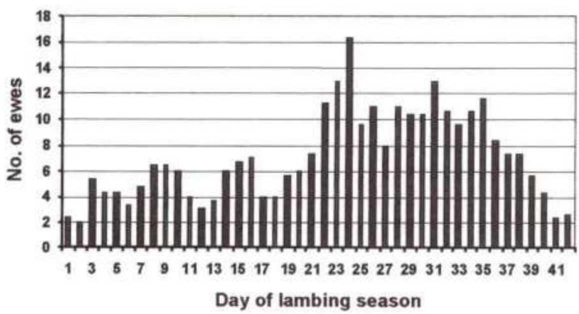
Lamb survival is good; the mortality shown in the table includes any dead-born lambs and any lambs that die between birth and weaning. About two-thirds of all lamb losses are classified as peri-natal (i.e. either born dead or died within 24 h of birth). In the Lowland system the incidence of lamb mortality was lower for twins (5.0%) than singles (7.5%). The difference reflected a difference in peri-natal mortality.

Annual ewe mortality is about 3.5%. Ewe and lamb mortality are well below the national figures for lowland or hill farms

Distribution of lambing

The spread of lambing over the lambing season is a key indicator of the labour required, as supervision will be needed regardless of the number of ewes lambing on any given day. The pattern of lambing is shown in Figure 1 for the last 3 seasons – day 1 represents the first lambing day in each year. This was March 21, 23 and 24 for 2005, 2006 and 2007, respectively.

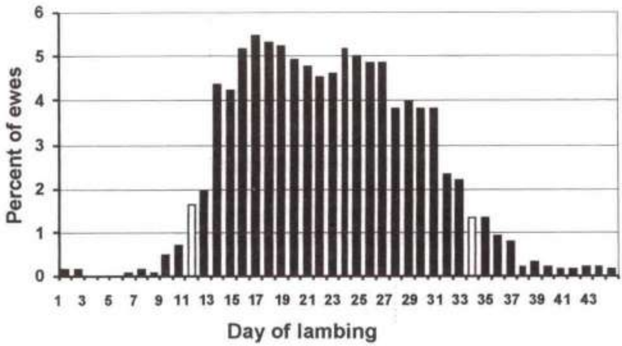
Figure 1. Actual daily incidence of lambing at Leenane – combined data for 2005 to 2007



As the Hill flock is put to the ram 3 weeks after the Lowland flock, the total lambing season lasts for 42 to 45 days. The last few ewes in the Hill flock lamb during the first week of May.

In order to combine the information from both Hill and Lowland flocks to get the lambing pattern that would occur if all ewes were put to the ram on the same day the lambing date was expressed as the number of days relative to the mean date for each flock. The combined information gave the pattern shown in Figure 2. This shows that just over 92% of the ewes lambed within a 20-day period - a very compact lambing pattern. This pattern means that during the 20-day period, 4 to 5% of the ewes would lamb each day - i.e. 8 to 10 ewes per day for a 200-ewe flock. This is about the number that lamb at Leenane under our current mating programme, but for a 340-ewe flock. If all ewes at Leenane were put to the ram at the same time the number lambing per day would be around 15 to 18 ewes - this could be managed without any difficulty given the present facilities at the farm.

Figure 2. Expected pattern of lambing at Leenane if all ewes were put to the ram at the same date - 92% of ewes lamb between days 12 and 33 inclusive



Conclusions

These results show what can be achieved on a farm that is well organised in terms of fencing and handling facilities, and has a well-defined annual management programme with only essential farm equipment for a sheep system. Total lamb mortality can be kept below 10% for flocks lambed outdoors on lowland without any supervision during the hours of darkness – in the present case this represents the hours between 9 PM and 6.30 AM – and with a break between 4.30 and 6.30 PM.

The lamb survival recorded at Leenane is achieved despite the very high rainfall at that location and the exposed nature of the site. The Lowland flock is achieving an output of 1.34 lambs reared per ewe to the ram, which is above the average performance for lowland flocks in the National Farm Survey. Thus, it can be argued that the performance of the Lowland flock in this study is a relevant and achievable target for well managed lowland flocks. However, the fact that ewes are lambed outdoors is probably a factor in the high survival rates achieved, in that it facilities the expression of natural mothering instincts, which are likely impaired somewhat under crowded indoor lambing conditions. It is also suggested that even if all ewes were put to the ram on the same day, one operator could manage the lambing as over 90% of the ewes would lamb within a 21-day period.

The results show that intensive night-time supervision is not essential and thus one of the periods seen as the major burden in flock management can be rationalised without prejudice to good animal survival - at least under the conditions that obtain at Leenane.

Extended grazing

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Introduction

Farm details are outlined in Table 1. Prior to 2004 lambing ewes started in February and continued in batches until mid April. The problem with this system was two fold. Firstly all sheep were housed for the winter, which was very labour intensive. Secondly, sheep were turned out as soon as possible after lambing to reduce the workload in the yard, resulting in a requirement for early grass, which was difficult to achieve with a stocking rate of 15 ewes per ha. In short, this was a high input high output system that required high levels of concentrate feed and fertiliser to keep the lambs thriving.

Table 1. Farm details

Owned & Leased land	91.5ha
Short term grazing (1-2 months)	60ha
Stubble turnips	12ha
Adjusted grazing area	102ha
Stocking rate	11.7 ewe equivalents/ha
Stock details	
Breeding ewes	
Belclare x	560
Suffolk x (Tullow)	400
Ewe lambs	260
Breeding Rams	
Texel (17), Suffolk (4), Belclare (5), Lleyn (3)	
Weaning rate (2007)	1.57 lambs per ewe joined to ram

In 2004 the farm was at a crossroads (parents retired from farming; pressing need to develop a system that was more labour efficient. The choices available were:

- invest heavily in a high fixed cost system of farming where new housing plus feeding equipment would be required;

Or

- look at alternatives, which would include no housing, reducing stocking rate, REPS (?) and outwintering the sheep on the Knockbeg system.

The latter option was taken, and to date is working successfully – one individual currently manages the farm, with a modest amount of hired labour at lambing time (usually students).

To operate the extended grazing system, about 40-50% of the ground is closed from October onward - for grazing in January. Ewes are block grazed in 24-hour blocks from about the middle of November (depending on grass supply and weather conditions). If the weather is excessively wet, ewes are put into the one-day grazing blocks earlier to avoid the grass being walked into the ground. On this farm the ideal pre grazing cover is about 1800 to 2200kg DM/ha. Grazing covers above this level results in poor utilisation and delayed regrowths. In general ewes are allocated between 1.3 and 1.5kg DM per head per day, which is measured using a plate metre before the sheep enter the grazing blocks. Ewes graze a new block each day and are not allowed to run over previously grazed blocks. Mating ewes while in one-day plots does not seem to have any adverse effect on litter size. After scanning, ewes are split into groups according to litter size. Any ewes that are dry are sold to the factory (only 3-4 year old ewes are given another chance).

Lambing 960 ewes together is a mammoth task, and so it often easier to split the task into two groups. The first group of 300 ewes start lambing on March 7, and the second group (660 ewes) start lambing on March .28. This is a much more manageable approach.

Single bearing ewes receive 1.3kg grass DM in the daily blocks until the first ewe lambs. Twin bearing ewes are released into the lambing paddocks three to four weeks pre lambing. Once the ewes are turned out on to the lambing paddocks, concentrates are fed daily in a single feed. Once lambing starts, concentrate feeding ceases (depending on grass supply) so as to reduce the risk of mis-mothering. Heretofore triplet-bearing ewes were grazed in a separate group and fed a higher level of concentrate feed prior to lambing. However, it may be a better option to house these ewes and feed silage and concentrates 10 weeks pre lambing (in 2006 about 120 ewes (12.5%) had triplets and these ewes caused the most trouble in the outdoor lambing system).

Single bearing ewes and first time lambing ewes give the least amount of trouble as they have nice tight udders and well positioned teats. The most troublesome groups have been the triplets and older ewes with low udders and bad teat positioning.

After lambing all lambs are tailed, vaccinated against orf and any male lambs are castrated. They are then moved to a new paddock. Once the lambs are three to four weeks of age they are forward creep grazed. There is no silage harvested on the farm (except surplus grass which is round baled as it arises). As silage ground is not closed up, ewes and lambs can graze more extensively. Paddocks are topped as required throughout the year and 14 units of CAN are applied after every second grazing (Except on grass clover swards).

A concerns when extended grazing and outdoor lambing was first started was that a proportion of the lambs would not be drafted until December and would therefore be competing with the ewes for grass. This has not materialised, and despite the fact that the majority of ewes do not start lambing until the end of March, 65% of the lambs are drafted by September 1, with all lambs gone off the farm by December 2.

2007 was the first year using tyfon and forage rape to finish lambs. Four hundred lambs were finished without concentrate supplementation off 16 acres of reseeded ground that was under-sown with tyfon. The success of this approach will merit a repeat exercise in the following years as part of a reseeding programme.

Finally, having the extended grazing system up and running, it is inconceivable that silage making and indoor lambing will ever be entertained again!

DAFF participation in the Malone sheep strategy implementation group

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Background

Following the publication of the 'Sheep Industry Development Strategy Report' in June 2006, it was decided that a group (under the chairmanship of John Malone - former DAFF Sec. Gen) be established *'To agree the process by which the 37 recommendations of the Sheep Industry Development Strategy Report of June 2006 should be implemented*'. The Sheep Strategy Implementation Group (SSIG), which comprised of representatives from across the sheep sector, was established on July 25, 2006.

The Department of Agriculture, Fisheries and Food (DAFF) as a partner in the group played an important role in the process, and in particular a numbers of areas detailed in this paper. It is important to acknowledge that the activities of the group were in collaboration and agreement between all of the parties involved. The areas detailed are those where the Livestock, Beef and Sheepmeat division had a significant input. Other Department divisions dealt more closely with areas such as the *'Bord Bia Quality Assurance Scheme*', REPS, Grant Aid for fencing and mobile equipment etc.

The areas focused on in this paper are:

- Lamb carcase classification;
- Mechanical classification;
- Price reporting system;
- Plans for upgrading the 'Genetic Improvement Programme'.

Lamb carcase classification (LCC)

It was widely acknowledged within the SSIG, that to attract the best price, lambs must be produced to the required weight and grade. It is also acknowledged that there must be a high level of consistency and accuracy in classification, and that the better quality carcase should attract a premium for the producer at factory level. The group recognised that a high standard of carcase classification was an important element in reaching an agreement on the introduction of 'Quality-based Payment System' (QPS). One of the key objectives of the group was the agreement and introduction of a QPS.

The purpose of the QPS is to ensure adequate reward for effort and investment at farm level in the production of better quality lamb, on a more consistent basis and for longer periods of the year. It is intended that the system should have a three-fold beneficial impact resulting in:

(i) a higher producer price for better quality lambs;
(ii) improved overall quality consistency in market offering;
(iii) improved overall image and the return available in the market place for Irish lamb.

The intention is that the QPS would be based on a combination of carcase quality parameters which would be used to make adjustments to a base price for lambs falling within a seasonal weight range. The quality parameters are:

- Carcase weight with a seasonal flexibility;
- Carcase fat score;
- Carcase conformation.

Ahe standard and consistency of lamb carcase classification is looked upon as one of the fundamental elements of a QPS. The DAFF gave a clear commitment to strengthen its involvement in lamb carcase classification (LCC).

Background to LCC

Lamb carcase classification in the Republic of Ireland is carried out in accordance with EU regulations using the EUROP Grid system. Abattoir personnel carry out the classification of lambs at the majority of export-approved abattoirs, on a voluntary basis. Even though LCC was introduced in 1996, it was not until September 2005 that all the abattoirs involved used the one system. Currently there are 7 export approved abattoirs participating in the scheme, which account for over 90% of the national lamb kill. Carcases are mostly classified using main classes, with some subdivision of fat classes.

Elsewhere in the EU, sheep carcase classification using the 'EUROP grid' is compulsory in only four countries; - Finland, France, Sweden and Germany. Similar to Ireland, Denmark and the UK classify ovine carcases using the EUROP grid on a voluntary basis. Carcase classification of lambs less than 13kg under the 'A grade' (light lamb only), takes place to a limited extent in Spain, Portugal and Greece.

The regulations concerning the Community Scale for the classification of ovine classification was originally drawn up in 1992 with the publication of Council Regulation 2137/92, and added to by Commission Regulation 461/93 and Council Regulation 2536/97.

Supervision

The resources available for the supervision of LCC have been greatly increased in the last number of years to meet the commitments given by DAFF in the area. The revised DAFF staff structure for classification comprises one Agriculture Inspector and one Area Superintendent, both based in Portlaoise, who are involved in LCC as part of their duties. Since mid 2006, four regionally based District Superintendents (DS) have been engaged in LCC as well as Beef Carcase Classification.

Each of the 4 DS's visits lamb abattoirs once each month and twice at busy times, a target of 15 visits in the year. Since January 2007 to the end of September 2007, there have been 83 visits to 7 export approved-plants (1.3 visit per plant per month). The average concordance, that is, the degree of agreement between the score of the abattoir classifier compared to that of the DAFF check, for conformation and fat main classes was 92.2% and 92% respectively, which is satisfactory. In June 2007, two EU Commission representatives visited Ireland and were satisfied with the standard of DAFF lamb classification.

Training & supervision
As part of the revamping of the classification system, DAFF in continuance with earlier exercises, held three separate training sessions at different venues for abattoir classifiers earlier this year (2007). The purpose of the training sessions was to give classifiers a brief overview and background to LCC. They participate in classification exercises involving the assessing and re- assessing of 50-60 carcases in the chill, followed by detailed and opened discussion of the carcases.

Also, on a day that a DAFF official carries out a visit to an abattoir on LCC duties, the DAFF official will carry out a detailed check of carcases in the chill. During the check, carcases that are incorrectly classified by an individual are identified. Following the check, the person who classified the carcase accompanies the DAFF official in the chill to look at carcases that are incorrectly classified. The priority is to 'fine tune' the individual and focus on 'border line' carcases i.e. a carcase that is near a class change, for example O+ or R- border etc.

Legislation
At the moment, DAFF are examining the prospect of introducing national legislation to strengthen EU regulations relating to lamb carcase classification, and to ensure a harmonised approach and adherence to LCC standards in export-approved plants throughout the country. National legalisation will principally be based on Council Regulation 2137/92 and Commission Regulation 461/93. Legalisation will also deal with the practical issues of running a scheme, the licensing and certification of classifiers etc. It is planned to have classification mandatory at the larger export approved abattoirs. The reaction of abattoirs and the industry to the introduction of national legislation is positive.

Price Reporting

It was recognised within the SSIG that an agreed price reporting system, which gives full information to producers on prices achieved in different plants on a graded basis, is an important element in building producer confidence in the production of better quality animals. The DAFF have agreed to put in place a price reporting system, where individual carcase data (weight, fat, conformation and price paid) would be collected from lamb abattoirs and a summary report of the prices generated each week.

It is planned that lamb abattoirs would forward data in an agreed format at the end of each week to a central database, managed by the DAFF. The data would be stored and processed by DAFF, and certain weekly and periodic reports would be generated. These price reports would be circulated to farm press and available on the DAFF website. The proposed system would loosely mirror a similar system that is in place for beef price reporting.

The accurate and representative reporting of lamb prices is somewhat difficult due to carcase weight restrictions used in the industry (no payment or reduced payment for carcase over a certain weight). To overcome this difficulty it is proposed to subdivide similar categories of lamb by using weight bands e.g. < 18kg, 18 to 21.9kg, > 22kg. The bands would mirror the weights used for the Quality Payment System. It is also proposed to categories the different types of sheep included in the price reported into one of the five agreed categories: Light lamb, New season Lamb, Lamb, Ewe and Ram.

As there is no compulsory legislative basis for lamb carcase classification or price reporting, the collection of raw data is dependent on the good will of participating lamb abattoirs. The DAFF have developed a system for collection, storage, analysis and publication, which is in place since early summer 2007. However, as abattoirs want to introduce a Quality-based Payment System (QPS) in unison with a price reporting system, and as no agreement has been reached between producers and abattoirs regarding the introduction of the QPS, no prices data have been made available for use in the system.

Objective Classification Trial

Recommendation 21 of the *Sheep Industry Development Strategy Report*, states '*Currently the industry is using the EUROP grading system. In the event that mechanical grading is proven to be a workable alternative the industry should convert to that system*'. In light of this recommendation it is the DAFF intention to carry out a mechanical classification trial in the spring of 2008. The initial trial was planned for late summer/autumn of 2007, however due to technical delays and lack of availability of suitable carcases, it was decided to postpone the start date of the trial to spring 2008.

The technology used to predict the conformation and fat classification of a carcase is Video Image Analysis (VIA). The way VIA works is that the system is integrated into the slaughter line, usually near to the scale area. Suspended carcases are illuminated and digital video images of each carcase are captured and processed using specialised software to extract data relating to the carcase shape or conformation. The fat level is determined via interpretation of the colour or grey level across the carcase. The image information can also be used to make predictions on carcase yield.

The pilot system uses two different cameras, one to capture an image of the back of the carcase and a second to capture an image of the carcase turned 90° to the side. Carcases passing thought the system, do not have to be stopped or held in place to have their image captured by the cameras. Following capture, the image data is evaluated with a special image processing software on a PC. VIA technology is already used by the meat industries in a number of countries - largely for classification of beef but also for classification of lamb.

The trial will comprise the collecting of images from approximately 1500 carcases - representative of the national lamb kill. By carrying out the trial in early spring of 2008, it is intended to have both new season and hogget lamb included in the sample. A proportion of the carcases will be used to validate or 'teach' the system, with the remainder used to test the system.

VIA machines can provide a rapid, repeatable, automated and objective way of assessing sheep carcase conformation and fatness. VIA machines can also be used to predict saleable meat yield from individual carcases. However, the upcoming trial does will not incorporate a meat yield component, as there is no demand from industry for the facility.

Plans for upgrading the genetic improvement programme

The group clearly identified the importance and the necessity for a national breed improvement programme that will improve the long-term value and profitability of the sheep industry. The need was recognised to broaden and develop the current programme as operated by DAFF, to include both pedigree and commercial flocks (the current programme only involves pedigree flocks).

Recommendation 6 of the *Sheep Industry Development Strategy Report* relates to the proposition that the Irish Cattle Breeding Federation (ICBF) should take over the genetic improvement programme for sheep from the DAFF. The recommendation states: *'ICBF should be involved in the development of breeding programmes, data capture and genetic evaluation and should take over the Sheep Breed Improvement Programme with immediate effect. The data currently available under the existing programme as well as initiatives being undertaken by certain breed societies in regard to data capture should be the starting point. It is accepted that adequate funding and resources should be provided to ICBF to undertake this task and all stakeholders should be involved. The additional work should complement and not undermine its existing role'*.

On request from the group, ICBF submitted a proposal in February 2007 for the development of a national sheep breed improvement programme. Under the proposal, an Irish Sheep Breeding Company (ISBC), a fully owned operating unit of ICBF, would operate the programme with funding provided by the DAFF to enable the development and expansion of the programme. The programme will be developed on a gradual basis and will involve both pedigree and commercial flocks to ensure that the commercial producers benefit from the genetic gain.

It was identified that a robust programme should be put in place with clear objectives and based on market signals. For the programme to succeed, a commitment must be given by breeders to be involved in the programme and for commercial producers to use the data produced. Some of the proposals include the broadening of the current programme to included both maternal (mothering ability etc.) and terminal (meat) traits. It is also envisaged that a new and special relationship between sheep breeding and the research/advisory services of Teagasc will be established, with strong linkage at farm level with specialist advisory programmes within Teagasc and monitor farms. It is also anticipated that the latest developments in genotyping, parasite and disease control will be incorporated in the programme.

The proposals envisage full use being made available of international expertise in order to insure the industry has access to world best practice without the need to carry large R&D overheads. The breeding objective is anticipated to be an economic one focused on the profitability of sheep production in the economic and physical environment of Ireland. The bulk of the work will be focused on the economic considerations associated with establishing the relationship between farm profit and trait variations.

To ensure success of the new programme, agreement and support from all interested parties is essential. It is recognised that a full and inclusive discussions on the subject is needed, to ensure success of the project. It is hoped that agreement from all the relevant parties can be reached without undue delay, and that a programme can be introduced as soon as possible. In the interim period, before a new programme is introduced, DAFF will continue to operate the current Pedigree Sheep Breeding Improvement Scheme.

In 2007, 144 pedigree breeders participating in the Pedigree Sheep Breed Improvement Programme, this figure is slightly down on earlier years. Table 1 gives a breakdown of the participating breeders in each breed.

Table 1. Participation in pedigree sheep breed improvement programme in 2006-2007

Breed	No. of Breeders
Suffolk	30
Charollais	11
Vendeen	14
Texel	86
Ild de France	1
Rouge De L'Ouest	1
Beltex	1
Total	**144**

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Future options for the Talbot farm

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Teagasc

Introduction

The Talbot farm comprises 228 ha in Ballacolla, Co. Laois. Most of the farm is in grass with a small amount in maize and spring barley. Fodder beet was grown on contract for the farm in 2007, but had been grown on the farm in previous years. Presently there are 240 suckler cows on the farm with 70% of these calving in the autumn. All of the cows are put in calf to Belgian Blue stock bulls, with heifers put in calf to a Limousin bull. Replacements are purchased as breeding heifers. Spring born bulls were sold live to Italy last year, with the autumn born bulls being finished out of the shed at 20 months of age (445kg carcass weight on average). Autumn born heifers are finished at grass, at 24 months of age (380kg carcass weight on average) and spring born heifers are usually finished at grass also at around 20 months of age (320kg carcass weight on average).

Current financial position

The Talbot's have completed the Teagasc eProfit Monitor for the last three years. The key figures from the 2006 analysis are given in Table 1, and are compared with the average figures compiled for 155 suckler farms in 2005 (All figures exclude the Single Farm Payment). The Talbot figures for 2006 are based on a 210-cow herd – the herd is now at 240 cows.

Table 1. e-Profit monitor analysis for the Talbot Farm in 2006

	Talbot's (2006)	Average (2005)*
Stocking rate LU/ha	1.87	1.78
Liveweight produced (kg/LU)	361	340
Liveweight produced (kg//ha)	675	605
Gross Output (€/ha)	1235	903
Variable Costs (€/ha)	697	466
Gross margin (€/ha)	538	437
Fixed Costs (€/ha)	353	437
Net Profit (€/ha)	185	0

*Average of 155 suckler farms in Teagasc e-Profit Monitor Analysis 2005

The stocking rate on the farm is 1.87 LU/ha and output per LU is 361kg, which would be typical for the system involved. The overall output/ha of €1,235 is considered high. This reflects high output/ha and the above average payment that is being received for the quality of the cattle that are being both slaughtered and sold live for export. Results from carcass grading places the farm in the top 5% for carcass conformation for 2006 slaughterings (based on ICBF carcass report). The variable costs/ha on the farm are high, while fixed costs/ha are low. Higher meal-feeding costs associated with the system of finishing, and the greater use of contractors on the farm keeps the variable costs high. Fixed costs are low in comparison to the average on good suckler farms in 2005, due to the low amount of machinery kept on the farm and the large land base diluting the overall overhead charges/ha.

Options examined

For the majority of farms the first option to consider, should be the benefit of efficiency improvements to the present system before any change of system is contemplated. Normally efficiency improvements will yield a much greater increase in profit than a change in system. Changing system will only offer potential profit improvement where the existing system is operated efficiently and the change of system does not require significant new capital investment. The labour requirement of a change in system may also be an important factor to consider.

Although the Talbot farm is already operating at a reasonably high level of efficiency, the areas that could be examined further would include grassland management to get increased gains from grass, the possible inclusion of white clover to reduce nitrogen requirements, breeding improvements (growth rate and conformation) and reducing replacement costs. The inclusion of alternative winter forages e.g. kale would also be worth considering as a means of reducing the costs of keeping suckler cows. Options involving indoor finishing will come under increasing pressure due to increasing concentrate prices unless beef prices rise significantly over the winter period. All of these 'efficiency' improvements when added together can add up to over €200/ha on a typical farm and do not need a change in system to be achieved.

All of the options examined below compare a number of relevant systems, all of which could benefit further from some or all of the efficiency improvements outlined above.

Future direction?

The Talbot's are now asking where do they go from here.

The key issues they have are: -

1. Should they remain with their current system of farming?
2. Should they move to 100% autumn calving?

3. Should they sell the best weanlings live?
4. Should they sell all of their weanlings live?
5. Should they join REPS?

To try and provide answers to these questions a full options analysis using the financial management package FINPACK was completed for the farm.

Options for the future

All of the options examined were kept at organic nitrogen stocking rate limits that would allow the Talbot's to join the REPS 4 scheme. Chemical nitrogen rates for each system examined were also compliant with what is expected to be allowed within the scheme. Therefore a REPS payment was given with each system and a cost for compliance with the scheme was also included. The Talbot's would not have to put up any extra slurry storage capacity over and above what they currently have, or are considering putting in place over the coming years. None of the options examined required further expenditure on fixed costs.

<u>1. Continue with current system</u>

Continue with the current system with 240 cows (70% autumn calving) and selling the progeny in the same manner and pattern as happened in 2006. Finished bulls sold at 310 c/kg dead. Heifers finished at grass at 300 c/kg dead. Spring born bulls sold live at €2.50 /kg live.

<u>2. Move to 100% autumn calving</u>

The same as option one but all 240 cows calving in the autumn, and all of the bulls and heifers finished with no calves sold live off the farm (existing facilities on the Talbot farm are adequate for all autumn calving – this is not the case on many farms).

<u>3. 100% autumn calving and the best calves sold live</u>

With this option, all of the cows would be calving in the autumn and the pick of the calves (accounting for 33% of the bull and heifer calves) to be sold live off the farm for the export trade. To maintain stocking rate (and hence keep output up) as a result of selling 33% of calves live, the herd would have to move up from 240 cows to 280 cows. It is assumed the bulls would achieve the same price as those in option one i.e. €2.50/kg and that the heifers would achieve €2.20/kg.

<u>4. 100% autumn calving and all weanlings sold live</u>

Instead of just the best calves being sold live, all of them would be sold live. The sale price is reduced by approximately 6% as all calves would not get the same price premium as achieved in option three. Bulls in this option are sold at €2.35/kg live and the heifers are sold at €2.10/kg live. Lower weanling weights (8% lower) are also assumed with this option compared with selling the top third as in option three. Again with more calves going at a younger age to keep output up the cow numbers would now have to increase to 340.

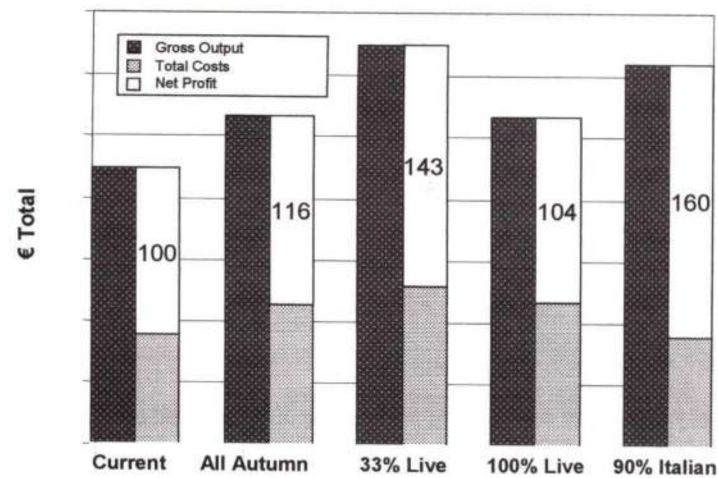
<u>5. Current system with a price equivalent to 90% Italian prices</u>

This option was put in to examine what effect a better beef price would have on the future direction the Talbot's should take. The beef carcasses they are producing would equal anything coming out of intensive feedlots in Italy. If they were to continue with their current system of farming i.e. ***Option 1*** and received a beef price for their beef at a level of 90% what was achieved in Italy in 2006 how would it compare to the other options? The Italian U3 bull price for the first six months in Italy in 2006 was (according to Bord Bia figures) 391c/kg. Pulling this back to a conservative price in comparison of 90% would leave it at 352c/kg. The Italian U3 heifer price for the second six months in Italy in 2006 was 407c/kg. 90% of this is 366c/kg.

Financial outcome

Figure 1 gives the financial outcome for the whole farm for each of the options examined. Gross Output, Total Costs and Net Profit are shown. The single farm payment is not included but the REPS payments are. The REPS payment adds over €7000 across each of the options after compliance costs are also taken into account.

Figure 1. Financial outcome of each option



The current option is showing a higher profit than is currently being achieved on the farm (2006 eProfit Monitor results). This is due to the higher output from the higher number of cows (240 vs. 210) and the inclusion of the REPS payment. While the variable costs would rise with the extra cows on the farm, the fixed costs have remained the same.

Moving to all autumn calving would suit the system of farming. Autumn calves are more suitable for finishing in a bull beef system than spring calving cows. This is reflected in the financial figures for this option with a rise in the output from the farm with the same number of cows (remaining at 240 cows). While the costs would also rise (especially the meal bill compared to selling the spring born weanlings live as currently happens), the extra output outweighs this to give a higher potential profit. The high carcass weights being achieved with the autumn born weanlings must be kept up for this to happen, otherwise the benefit of the high output will be lost.

Selling the best of the weanlings on the live export market looks the most attractive option. These can achieve a high price/kg and the remaining stock can be finished on the farm in the same systems that are being used at the moment. Moving to selling all of the weanlings live is not an attractive option where sale price/kg is 6% lower and weanling weight is 8% lower compared with selling the top third. The Talbot's would be calving 340 cows for no extra obvious benefit. The main reason why this falls so far behind the previous option, is that the drop in output value is not compensated for by a large enough reduction in costs. Even though there are significantly more cattle being sold, their lower value/kg (you will not get the same premium price for 100% of your weanlings) and the lower sales weights from the farm reduces the output.

Including a beef carcass price equivalent to 90% of what was achieved in Italy in 2006 shows just why there has been a demand for the quality of weanlings on the Talbot farm, for shipping to Italian feedlots. If this price could be paid in Ireland for such carcasses, there would be no question about what route to take. Instead they are going to be forced to sell their best weanlings abroad rather than finish them on the farm of rearing.

Conclusions

The Talbots have invested heavily over the last decade in both infrastructure and breeding stock. They are now producing the type of animal and carcass that can rival any beef farm on the continent. They have the added benefit of having a long grazing season that allows them to compete on the costs of production.

From the options examined a number of conclusions can be drawn. It will cost very little to join REPS 4, and they should seriously consider doing so as no matter which option is selected, it will provide an additional €7,000 revenue after compliance costs. Whichever system they decide to go with they would be better moving to an all-autumn calving herd. While there is such a high differential between what can be got for finished beef out of intensive feedlots on the continent and what can be achieved in Ireland, they have the quality of stock needed to continue to supply these feedlots. Choosing the top third of weanlings to supply this market would be the target to begin with. This will however require increasing cow numbers on the farm. If greater numbers of weanlings can be sold live into this market without a drop in price or weanling performance (e.g. if 50%

were suitable at the maximum price) then it would make sense to follow this route and increase cow numbers even further.

As pointed out already, apart from making a significant change to a beef system on a farm, considerable gains can also be made across all systems by targeting improvements in efficiency levels (extra gains, lower costs) to increase the bottom line. A €100+ per ha gain through any improvement in efficiency would improve the profit levels on this farm by over €25,000.