Irish Grassland Association Journal

2001 VOLUME 35

Irish Grassland Association

Corporate Members 2001

AIB
Alltech
Bank of Ireland
Corby Rock Mills Limited
Dawn Meats
Drinagh Co-Op
Foran Chemicals Limited
Glanbia
Goldcrop Limited
Greencore Agribusiness
I.A.W.S. Group plc
Irish Dairy Board
Irish Farmers Journal
Irish Fertilizer Industries
Richard Keenan & Company
Lely Ireland Limited
Mullinahone Co-op
New Zealand Cattle Limited
Premier Molasses Co. Limited
Slaney Meats Limited
Timac Limited
Town of Monaghan Co-Op
Wexford Milk Producers Limited

Teagasc Education and Advisory Services

Ballyhaise Agricultural College
Cork East
Cork West
Kildalton Agricultural College
Kerry
Laois
Limerick
Regional Office South, Kildalton
Regional Office North, Grange
Roscommon
Tipperary North
Tipperary South
Westmeath
Wicklow

Irish Grassland Association

JOURNAL

Vol. 35 2001

Edited by
David McGilloway

ISSN 0332-0588

Printed by Walsh, Printer, Roscrea

CONTENTS

COUNCIL 2001-2002

Irish Grassland Association, Moneymore, Borris in Ossory, Co. Laois.

Telephone/Fax: 0505 41025 email: grassland@eircom.net

The Purchase For Destruction (PFD) Scheme

JARLATH COLEMAN
Principal Officer, *Beef Market Supports Division, DAFRD, Johnstown Castle, Co Wexford.*

1. EU Regulation

Commission Regulation (EC) No 2777/2000, which provides for exceptional support measures for the Beef Market came into force on 1 January 2001. The measures were negotiated at EU level late last year in the context of the BSE related difficulties facing the beef sector, and were designed to restore consumer confidence in beef and to provide an effective market support for cattle. The regulation provides for testing for BSE and the destruction of animals over thirty months of age up to July 1.

1.1 Testing

From the 1 January all animals over 30 months entering the food chain must be tested. Non-tested animals must be destroyed. The EU provides funding of 15 Euro per animal tested. Animals over 30 months which have been tested negatively, are not allowed into the destruction scheme except where derogation is given under the EU Beef Management Committee procedure. Where tested animals enter the destruction scheme, the EU will not fund the test.

1.2 Destruction

The basic prices paid by Member States to producers or their agents for cattle submitted under the scheme is based on the standard EU dressed carcase weights and the average price for each category and quality within that category in a four week reference period, 6 November – 1 December. The weighted average price or flat price for each category is calculated on the basis of 1999 classification data on grades and weights. The average price paid for each category in a number of selected member states is outlined in table 1.

Country	Cow		Steer	
	Ave O3 price (E/kg)	Flat rate price/animal (E)	Ave R3 price (E/kg)	Flat rate price/animal (E)
Ireland	1.55	407	2.33	776
France	1.97	674	2.67	1018
Belgium	1.83	777	-	-
Germany	1.79	520	-	-
Holland	2.02	597	-	-
Spain	1.50	400	-	-

Table 1. Flat rate prices for cows and steers in selected member states under the PFD scheme

The regulation provides for the upward adjustment of these prices by 5% subject to market conditions. EU financing does not apply to this amount. Any adjustment above 5% or below the basic price can only be made upon prior approval from the Commission. The 5% increase has been applied in Ireland for steers and heifers.

Prices for each of the 28 grades within each of the four categories are published weekly (see Annex 1). The current prices in Ireland for a selected grade within each category are as follows:

Steer	R3	91.2 p/lb (including VAT @ 4.3%)
Heifer	R3	91.6 p/lb
Cow	O3	57.7 p/lb

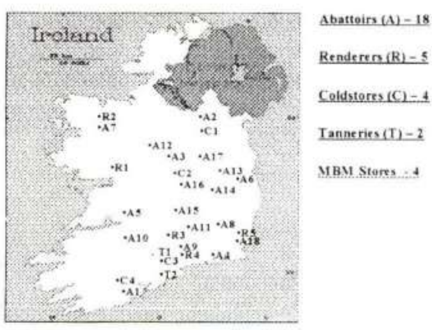
Prices are subject to weekly review.

Eligible Animals
Animals over 30 months of age, and which have not undergone a test can be offered for slaughter and destruction by any producer. Only animals, which have been present on a holding in a Member State for at least six months and have been passed fit for slaughter for human consumption, are permitted into the scheme.

Operation And Financing
The EU provides 70% of the standard flat rate price of the animal, with all other costs borne by the national authorities. In the operation and control of the scheme very strict conditions apply: there must be total separation of animals and products entering PFD from animals entering the food chain; all parts of the animal entering PFD must be rendered, the only part excepted is the hide which can be sent for tanning but must be treated separately from non-PFD hides; the trimmings fatty tissue etc, on the hide must be destroyed. A EU advance of 80% can be claimed once all products from the animals on which the claim is made are rendered and the hide disposed. The balance can be claimed when the meat and bone meal is incinerated. Administrative and on the spot checks must be carried out to verify that all relevant products have been rendered and fully destroyed.

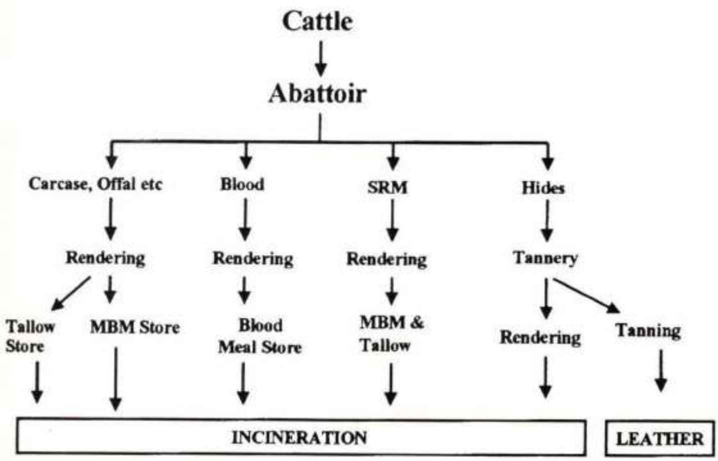
Operation of the scheme in Ireland
The Department of Agriculture, Food and Rural Development administers the scheme in Ireland within its Market Supports Division in Johnstown Castle and through the network of veterinary and agricultural officers located throughout the country. These staff ensure that every aspect of the scheme - at abattoir, rendering plant, cold store, meat and bone meal store, tannery, etc, - are strictly controlled to ensure that the requirements of the EU Regulations are fulfilled. The location of the various participating plants involved in the scheme is given in Figure 1, while the flow chart in Figure 2 provide an outline of the process involved along the chain to final destruction. Each stage of this process involves controlled scheduling to overcome bottlenecks, etc. to allow for the scheme to

Figure 1. The locations of the various participating plants involved in the PFD scheme



operate efficiently. Accordingly, there is a daily limit imposed in the number of cattle, which can be slaughtered in each abattoir. This limit may be reduced if the outlet for PFD material at any stage further along the chain is limiting. All PFD material from each day's slaughtering must be removed from the abattoir, including the hide.

Figure 2. An outline of process involved in PFD scheme



Slaughterings under the scheme
Since the scheme commenced on January 10, 41432 cattle have been slaughtered up to February 2. A breakdown by category is given in table 2.

Table 2. Breakdown of animals by category slaughtered under the PFD scheme

Week Commencing	Category				
	Bulls	Steers	Cows	Heifers	Total
8 Jan	17	2519	1281	341	4158
15 Jan	53	5890	4705	1168	11816
22 Jan	83	5017	4595	1193	10888
29 Jan	117	8745	4156	1552	14570
Total	270	22,171	14,737	4254	41432
% Of Total	1%	53%	36%	10%	100%

Classification
A breakdown by weight of animals slaughtered under the scheme compared with animals slaughtered in the first quarter of 2000 and for the full year is given in table 3.

Table 3. Average weights of PFD carcases compared with cattle slaughtered in 2000

Category	No of PFD animals	Avg. weight of PFD animals (kg)	Avg. weight all animals (Jan.– March) 2000 (kg)	Avg. weight all animals (Jan. – Dec.) 2000 (kg)
Steers	13427	361	337	340
Heifers	2671	294	266	267
Cows	10606	285	283	286
Bull (old)	155	485	478	470

This table shows that the average weight of steers and heifers entering the scheme are substantially higher than the average weight of all slaughterings within these categories in 2000. Some of this variation would be accounted for by over 30 month animals being naturally heavier than the average of all cattle in that category. Weight gain arising from the delay in slaughtering would also account for the increase. A breakdown of the average weight for each category of animal submitted under the scheme in the first three weeks in the scheme is given in table 4.

Table 4. Average weights of carcases by category under PFD scheme in the first three weeks of scheme

Week commencing	STEERS		HEIFERS		COWS	
	No.	Avg. Wt.	No.	Avg. Wt.	No.	Avg. Wt.
8 Jan 2001	2520	356	341	293	1279	286
15 Jan 2001	5893	363	1147	295	4273	286
22 Jan 2001	5014	362	1183	293	4604	284

Conformation

In table 5, the conformation of steers submitted into the scheme is outlined.

Table 5. Conformation of steers slaughtered under PFD scheme (Jan 1 - Jan 20, 2001) compared to 2000 classification conformation data

	U	R	O	P
PFD scheme (animals)	5%	49%	42%	4%
All Animals 2000	5%	44%	46%	5%

While the PFD sample is small, the conformation results are very similar to the national conformation figures for steers in 2000.

PFD kill projections

The number of cattle which enter the PFD scheme under the terms of the current regulation which expires at the end of June, will amongst other factors be determined by the market situation in the EU, availability of third country markets and the level of market supports available under intervention and export refunds. Recent estimates from the Commission show a major drop in consumption in the EU. In addition a considerable backlog of production, which should normally have taken place in 2000, has been carried over into 2001. The number of cattle entering the scheme will of course, be a function of the number of over 30 month animals coming on the market and the level of BSE testing carried out on those animals.

No of animals over 30 months

The Department's CMMS data shows that over half of all animals slaughtered in export and domestic abattoirs in 2000 were over 30 months of age. This is shown in Table 6.

Table 6. Breakdown of slaughterings by age in 2000 (all abattoirs)

	(000' Head)					
	Jan. – Dec. 2000		Jan. – June.		Jan. – March	
	No.	%	No.	%	No.	%
Total Slaughterings	1825	100	976	100	512	100
			56			
Under 30 Months	858	41	549	56	274	54
Over 30 Months	967	53	427	44	238	46

Source CMMS, DAFRD

If the cattle supply pattern is somewhat similar this year as in 2000 then some 430,000 cattle, in addition to the backlog carried over from 2000, would be eligible for the scheme.

No of animals tested

The total number of animals tested for BSE under the ENFER technique up to February 2 is 40,429 of which all tested negative. The breakdown per week is given in table 7.

Table 7. Weekly breakdown of number of animals tested

Week beginning	No. of animals tested	No. BSE positive
1 Jan	4362	0
8 Jan	11673	0
15 Jan	10148	0
22 Jan	8677	0
29 Jan	5569	0
Total	**40429**	**0**

The table shows that there is a large reduction in the numbers being tested at the end of January as against the middle of the month. The corollary of this is that the numbers of cattle entering the PFD scheme has been on the increase.

ANNEX 1

	Steers (p/kg)	Heifers (p/kg)	Cows/Bulls (p/kg)
E1	207.43	214.31	147.93
E2	207.43	214.31	148.59
E3	207.33	214.31	149.93
E4L	206.36	214.31	148.59
E4H	206.36	214.31	148.59
E5	204.05	214.31	147.93
U1	207.43	212.34	142.72
U2	207.43	214.31	143.37
U3	207.33	214.31	144.71
U4L	206.36	212.34	143.37
U4H	206.36	212.34	143.37
U5	204.05	212.34	142.72
R1	199.94	197.99	137.50
R2	199.94	197.99	138.16
R3	201.18	202.03	139.50
R4L	200.41	202.18	138.16
R4H	200.41	202.18	138.16
R5	199.12	195.66	137.50
O1	183.28	190.65	118.43
O2	193.15	190.65	118.43
O3	195.85	196.49	127.14
O4L	195.73	197.38	132.68
O4H	195.73	197.38	132.68
O5	194.38	192.12	135.64
P+1	182.16	171.47	78.25
P+2	182.16	171.47	102.08
P+3	184.97	171.47	115.21
P+4L	185.20	176.66	124.95
P+4H	185.20	176.66	124.95
P+5	182.24	171.47	127.95
P1	182.16	160.52	75.66
P2	182.16	160.52	84.19
P3	184.97	160.52	94.83
P4L	185.20	165.71	100.13
P4H	185.20	165.71	100.13
P5	182.24	160.52	104.30
P-1	162.49	149.57	71.77
P-2	162.49	149.57	71.77
P-3	162.49	149.57	71.77
P-4L	162.49	154.76	71.77
P-4H	162.49	154.76	71.77
P-5	162.49	149.57	71.77

Restructuring the beef industry: - impact of finishing under 30 months

BERNARD SMYTH
Chief Beef Adviser, Teagasc, Grange

Introduction

This paper discusses the relationship between profitability and cattle 'finishing age'. Current finishing ages and reasons for later finishing in Ireland is examined. For the future, some implications of finishing progeny from both dairy and suckler herds under 30 months is considered.

Finishing age - maximising profitability

To achieve maximum profitability from an integrated suckling to beef or dairy calf to beef enterprise, high animal performance, cost efficient production and optimisation of premia must be attained. The optimum finishing age to achieve maximum profit for a spring calving herd is at 20 months for heifers off grass, and 23 - 24 months for steers at the end of the second winter. Some farms with suckler herds can also achieve near maximum profit when steers are let out to grass in spring at 22 - 23 months of age and finished off grass at 28 months of age. [NB. Present and future market requirements dictate all animals must be finished before 30 months of age].

Irish cattle herd

The CSO data in Table 1 shows the Irish cattle population at approximately 7.2 million head in June 2000, which includes almost 1.3 million dairy cows and just over 1.1 million other cows. Animals 2 years of age or older amount to 792,100 males, which represents approximately 75-80% of spring 1998 live male calvings, and 345,700 heifers which represents approximately 35% of spring 1998 live female calvings.

Table 1. Irish cattle herd – million head

	Dec. 1999	June 2000	Dec. 2000
Dairy Cows	1,260,900	1,270,300	1,238,300
Other Cows	1,132,300	1,149,900	1,121,100
In-calf Heifers - Dairy	205,800	201,700	198,400
- Other	100,400	99,100	112,600
Bulls	38,200	44,600	40,100
Other Cattle			
Male - 2 yrs and over	536,700	792,100	494,900
Female - 2 yrs and over	284,300	345,700	247,600
Male 1-2 yrs	944,600	955,000	833,200
Female 1-2 yrs	551,500	616,300	479,500
Male Under 1 yr.	881,700	908,000	916,300
Female Under 1 yr.	771,100	849,300	777,300

Source – Central Statistics Office

December 2000 figures show the national herd at its lowest level since 1995 at just fewer than 6.5 million head. Males and females over 2 years are down approximately 42,000 and 37,000 head respectively compared with December 1999 levels. Cattle 1-2 years are down over 180,000 head compared with December 1999, while cattle under 1 year are up 40,000 head.

Finishing age - present position

Data from the CMMS on the age profile of animals slaughtered in 2000 (source DAFRD) shows the challenge that exists for Irish farmers to ensure that future slaughterings are achieved before dairy and suckler herd progeny reach 30 months. Table 2 shows total slaughterings for 2000 as captured in the CMMS and the breakdown in each age category, and also shows a Teagasc estimated breakdown by age category when cows slaughterings are excluded.

Table 2. Total slaughterings in 2000 and % by age category

Total Slaughterings (million head)	Including Cows * 1.86	Excluding Cows ** 1.5
Breakdown by Age Profile		
% To 24 months	18%	22%
> 24 - 30 months	30%	38%
>30 - 36 months	22%	27%
>36 - 48 months	13%	13%
>48 months	17%	-

*CMMS data from DAFRD

**Teagasc estimate assuming 360,000 cow slaughterings all over 36 months of age

Table 2 shows that 60% of slaughterings excluding cows in 2000 are achieved before animals reach 30 months of age and up to 40% of slaughterings of steers or heifers at over 30 months. Animals (other than cows) slaughtered at over 36 months only amount to 13% and will present the greatest challenge at farm level to have them fit for slaughter at least 14 to 15 month earlier. Up to 27% of animals slaughtered between 30 to 36 months (average age 33 months) will need to be finished at least 4 to 5 months earlier. This will require extra concentrate input where grazing management and grass quality are not up to a high standard.

Table 3. Slaughterings in 2000 excluding cows*

Total Slaughterings excluding cows (million head)	Jan. to 30th June 0.775	July to Dec. 0.73
Breakdown by Age Profile		
% to 24 months	26%	19%
> 24 - 30 months	45%	29%
> 30 - 36 months	16%	38%
> 36 - 48 months	13%	14%
Over 48 months	Nil	Nil

*Based on CMMS data for total slaughterings and assuming all cow slaughterings in 2000 were animals over 36 months

Table 3 looks at the disposal pattern in 2000 up to June 30th and from July to December. As would be expected with a predominantly spring calving herd the age profile of slaughterings gets older as the year progresses with up to 38% of steer and heifer slaughterings in July to December aged between 30-36 months. This represents approximately 277,000 steers and heifers slaughtered in the second half of the year that would need to be finished at least 4 to 5 months earlier. There was little difference in slaughterings of steers and heifers in the 36 to 48 month age category between the two halves of 2000.

Reasons for later finishing in Ireland

The small number of integrated breeding and finishing farms within both dairy and beef herds, combined with too many farm movements in the animals lifetime extends the time required to achieve adequate finish beyond 30 months. Farm movements can often result in an extended store period that significantly effects days to slaughter.

High calf/store prices relative to Irish beef prices, encouraged later finishing that included the maximum period at grass to keep costs down, and to achieve a higher carcass weight to spread the calf/store cost.

The attraction of animals with compensatory growth (following a store period with poor performance) to finishers, presented a better prospect for profit when age at finishing was not a marketing issue.

Implications of finishing under 30 months

In the short-term, in many situations there will be increased costs to get the present animals approaching 30 months finished some 4-6 months earlier than previously. A critical group is animals born in March and April 1999 that will reach 30 months by the end of August and September respectively this year. Table 4 shows the critical dates when animals arrive at 30 months up to January 2002.

Table 4. Data of birth and under 30 months finish target

Born On	Under 30 Months Until
1st Sept. 1998	28th Feb. 2001
1st Oct. 1998	31st March 2001
1st Nov. 1998	30th April 2001
1st Dec. 1998	31st May 2001
1st Jan. 1999	30th June 2001
1st Feb. 1999	31st July 2001
1st March 1999	31st Aug. 2001
1st April 1999	30th Sept. 2001
1st May 1999	31st Oct. 2001
1st June 1999	30th Nov. 2001
1st July 1999	31st Dec. 2001
1st Aug. 1999	31st Jan. 2002

Animals approaching 30 months should be grouped according to age and a feed strategy put in place to ensure finish before 30 months in order to increase sale options. Additional costs will only be justified where market prices for under 30 month animals exceeds the price for over 30 month animals. At present (Feb. 2001) markets are weak with under 30 months price below PFD price but as the year progresses extra market outlets combined with a recovery in beef consumption within the EU and any disimprovements in the PFD scheme price would change the balance significantly. From Table 3 it can be estimated that approximately 277,000 animals (excluding cows) aged 30 to 36 months, with average age 33 months, were slaughtered from July to December 2000. It can also be estimated from December 2000 CSO data that approximately 200,000 head are in the pipeline for slaughter in July to December 2001 in the 30 to 36 month age bracket. Earlier finishing of this group of animals in 2001 will bring additional under 30 month cattle to market some 4 to 5 months earlier and would weaken prices unless significant additional sale outlets become available. The present PFD scheme is to run to June 2001 and could have price adjustments between now and June and will also be due for review from then on.

Given the present weak markets the incentive is not there to speed up the finishing of animals to achieve finish less than 30 months before the end of June next where extra costs are required to finish earlier. However earlier finishing without extra costs through better use of early grass and good grazing management is essential and could provide more marketing options to farms with cattle approaching 30 months between now and June. Any review of the PFD scheme from July is unlikely to maintain the buying price for steers and heifers at present levels and is a major factor that must be considered when decoding if the risk of putting in extra inputs are justified, to ensure animals are finished some 4 to 5 months earlier. The big question is the market price for under 30 months beef to June compared with PFD price for over 30 months post July.

Medium term impact of earlier finishing

Estimates from slaughterings in 2000 from CMMS data would indicate that approximately 405,000 animals (excluding cows) were slaughtered at an average age of 33 months. Under 30 month finishing for this group would require their sale some 4-5 months earlier which would remove 135,000 to 170,000 livestock units from Irish finishing farms. In addition, an estimated 200,000 plus animals with average age 42 months (age group 36-48 months) would need to be finished some 14-15 months younger which would remove a further 230,000 to 250,000 livestock units from finishing farms.

Achieving the finishing of all bullocks and heifers under 30 months in future would remove 370,000 to 420,000 livestock units from Irish finishing farms. Up to now farms finishing bullocks and heifers over 30 months will have to purchase younger stock (dairy beef calves/suckler and dairy beef weanlings) and finish them under 30 months or alternatively purchase suckler quota to supply some or all of their stores.

Live exports in 2000 amounted to approximately 400,000 head but demand slowed down in the second half of the year and may continue at a much lower level of demand in 2001. Demand from home finishers for younger cattle has remained very strong and Irish feeders are likely to remain the best customers for quality young stock in 2001.

The price of younger cattle is seriously out of line given the present beef price for cattle under 30 months.

Assuming that the demand for live exports recovers in 2002/03 to last years level, and that home finishing of steers and heifers is predominantly under 30 months, this will result in a significant reduction in cattle livestock units on Irish farms. This will release up to 0.5 million acres of mostly non eligible land that is not required by other livestock enterprises due to quotas on milk, ewes and suckler cows. Much of this land released will be available for forestry, as it will have few if any alternative uses.

Summary

Present and future market requirements dictate that cattle must be finished before 30 months of age in order to gain access to most markets. Animals over 30 months can have market access in future when tested for BSE but the price is likely to be lower unless supplies of under 30 month animals are limiting, or if the over 30 month beef meets a specific carcass specification in terms of grade and carcass weight and qualifies for an extra premium.

Estimates based on CMMS data for slaughterings in 2000 indicate that 60% of Irish steers and heifers were slaughtered under 30 months. However in the second half of 2000, slaughterings of steers and heifers under 30 months only amounted to 48% of total slaughterings excluding cows - this is to be expected from a spring calving herd with many steers finishing at 30 to 36 months off grass. A similar age profile to disposals in 2001 will expose a large number of animals to a market price for BSE test and sell, or leave them dependent on a extended PFD scheme from July at possibly a lower price than at present, or encourage earlier finishing with possible extra costs to achieve sale before 30 months. Selecting the best option here is not easy with selling price uncertain in all cases but risk can be reduced by not having all the eggs in the one basket.

Farmers with cattle finishing at present and for the remainder of 2001 are the most exposed to present market difficulties and will have to rely heavily on the PFD scheme for cattle over 30 months. Based on the age profile of slaughterings in 2000 it is estimated that over 200,000 animals normally destined for slaughter in the second half of 2001 would need to have their sale date brought forward by some 4 to 5 months to achieve finish under 30 months. Bringing forward sales of under 30 months cattle onto an already difficult market will not help sale price unless significant market outlets reopens between now and the summer. Extra costs incurred to achieve the earlier finish under 30 months can only be justified by having a secure outlet compared with facing a much more uncertain outlet and price for cattle over 30 months after July 1st.

Every effort should be made to finish and sell cattle already 30 months, or due to reach 30 months by June, into the present PFS scheme before the end of June on the basis that it can be expected to return a better price than any alternative scheme that might replace it from July 1st next. Over 100,000 steers and heifers aged 36 to 48 months were slaughtered from July to December 2000 and corresponding animals in 2001 will be over 30 months before June 30th and therefore eligible for present PFS scheme.

It is possible that by March/April there may be indications from the EU of how the present PFD scheme might be extended or replaced with alternative market support measures and any such changes could change or help clarify the best options available.

Finishers depending on purchased stores up to now for their raw material, will need to change their systems to acquire younger animals and finish them before they reach 30 months. With a much reduced level of live export demand in the short term the supply of younger stock will be adequate to maintain total livestock units on Irish farms. Profit levels with finishing systems are likely to remain tight and volatile while efficient breeding and finishing farms will have modest but more stable profits. The need for lower cost production with the exploitation of grass management and quality winter feed becomes even more important at lower selling prices and are both essential ingredients in finishing under 30 months. Increased linkage between breeding and finishing farms with more efficient marketing can help eliminate prolonged store periods, which is essential to facilitate earlier finishing. Better co-operation between finishers and processors can ensure beef production systems that supply beef to meet the highest standards required by EU consumers where a viable profit is achievable by all involved.

Producing cattle under thirty months old

M.G. KEANE and M.J. DRENNAN
Grange Research Centre, Dunsany, Co. Meath.

Introduction

For many years farmers have been encouraged to produce two-year-old beef. There were circumstances where finishing cattle off grass at up to 30 months of age was sometimes a better option but never has the production of beef over 30 months been recommended. Nevertheless, it appears that there are a large number of prime cattle over 30 months on Irish farms. These are mainly steers. This is extraordinary considering the high level of concentrate consumption by beef cattle nationally which averages about 0.75 t per animal slaughtered (including heifers and cows). Over recent years, carcass weights have decreased so with more concentrates being fed and lighter carcasses; slaughter age would be expected to have declined.

While there is no reason to believe that prime cattle over 30 months pose any greater risk to human health than those under 30 months, the 30 month cut off point has become established in the consciousness of consumers, supermarkets and meat traders. Therefore, for the time to come only animals under 30 months are likely to be acceptable as prime beef. This may mean slaughter at somewhat lighter weights than at present, something which could be desirable as many carcasses are overfat (42% of steers and 47% of heifers in fat classes 4H and 5 in 2000). Whenever it is suggested that animals should be slaughtered younger or lighter, this is often interpreted as a recommendation for earlier maturing breed types. This is not so, all breed types can produce carcasses of acceptable weight and finish at less than 30 months.

Margins from systems

Generally over the years, margins per ha from cattle enterprises increased with decreasing slaughter age. This is still so even though intensity of production is now fairly rigidly fixed through the stocking rate limits for the Special Beef Premium, the Extensification Premium and the Rural Environment Protection Scheme (REPS). Data on the economics of the three systems compiled by Caffrey (2000) are shown in Table 1. All are operated at the same level of management and all are eligible for REPS. System 1 produces 68 continental x Friesian steers annually at 24 months with a mean carcass weight of 360 kg. The net margin (including REPS) is £828/ha. System 2 produces 56 cattle annually, roughly half at 24 months at 360 kg carcass weight and half at 30 months at 410 kg carcass weight. Net margin is £715/ha. Summer finishing of steers to 30 months gives a lower gross margin. Clearly, as slaughter age declines from around 30 months to around 24 months, net margin per ha increases. Net margin per animal increases as slaughter age and weight increase but in the vast majority of farms in Ireland, land rather than animals is the limiting factor so the margin on land should be maximised.

Seasonality of calf births

Date of birth influences date of slaughter. The distribution of calf births by 2-month periods throughout the year and for the 3 - month period February to April is shown in Table 2. Almost 90% of all calves are born in the first 6 months of the year with almost 70% born in the February to April period. Differences between dairy and suckler herds are small. More dairy cows calve in January/February while more suckler cows calve in May/June. Over 56% of dairy calves are born in February and March and over 51% of suckler calves are born in March and April. This very pronounced pattern of spring calving means that approximately 80% of animals will reach 30 months of age before October of their third year.

Complete production systems

Dairy calf to beef system (24 months)

The target weight gains and weights for a 24-month dairy calf to beef system are shown in Table 3. The values for Friesians also apply to early maturing animals but the latter would have a shorter finishing winter and a lighter slaughter weight. The highest target weight gain at any time throughout life is 0.95 kg/day, and mean lifetime liveweight gains are 0.77 kg/day for Friesians and 0.82 kg/day for continental crosses. These targets are not be too difficult to achieve but even if the final target weights are not achieved by 24 months there is still plenty of time to reach them before 30 months. Slaughter weights are 615 and 660 kg for the Friesians and continental crosses, respectively giving corresponding carcass weights of 320 and 360 kg. These carcasses are adequately finished.

Suckler system (24 months)

Target weight gains and weights for a 21 month (heifer) and 24 month (steer) spring calving suckler system are shown in Table 4. It is assumed that the animals are three-quarter or more continental crosses and so have the potential to be taken to heavy weights. Only during the suckling period at pasture does target liveweight gain exceed 1 kg/day. Mean lifetime liveweight gains are 0.89 and 0.85 kg/day for steers and heifers, respectively. The heifers are finished at the end of the second grazing season and over the early part of the second winter either on concentrates at pasture or on silage plus concentrates indoors. Target slaughter weight for heifers is 570 kg giving a carcass of about 310 kg. Lower slaughter and carcass weights would be acceptable. The steers are finished at two years at a slaughter weight of 700 kg and a carcass weight of 395 kg. Again lower slaughter and carcass weights would be acceptable. As with the dairy bred animals, the final liveweight targets are for 24 months finishing (steers) so there is still plenty of time to reach the targets before 30 months even if some of the production phase targets are not met.

Pasture finishing

Since the vast majority of calves are spring born and must now be slaughtered before 30 months of age, the opportunities for finishing off pasture in the third grazing season are less than heretofore. For early born (before March) calves, which would be 26 months of age or more before the commencement of their third grazing season, there is little point in putting them to pasture - they should be finished indoors during their second winter. Later born (after March) calves however, could either be finished indoors or at pasture. Target weight gains and weights for late born (mid May) suckler calves finished off pasture in their third grazing season are shown in Table 5. Late born calves at first housing as weanlings, will weigh about 250 (steers) and 220 kg (heifers). During the first winter, performance is the same as for earlier born animals. Because the steers are not being finished over the second winter they can be kept at pasture later, and steers and heifers at housing for their second winter weigh about 520 and 470 kg, respectively. The steers are stored over the winter while the heifers are finished for a 100 day period and slaughtered in February. The steers which weigh about 590 kg are turned out in early April for an 18 week finishing period at pasture and slaughtered at 27 months of age. This system can also be applied to late born dairy calves with appropriate modifications to the targets. In principle, turn out for a third grazing season can be considered once the animals can have about 3 months at pasture. If the pasture finishing period is much shorter than this then turn-out is hardly worthwhile and the animals should be finished indoors.

Partial systems

All of the foregoing has dealt with complete systems and in theory it should not matter whether the entire production cycle is carried out on one farm or if each production phase is carried out on a different farm once the animals achieve their target weights for age. In practice however, where animals are sold from one farm to another many are below the target weight for age. If purchased animals are below the target weight for age but still must be slaughtered before 30 months, higher weight gains for the remainder of life must be achieved or alternatively slaughter weight will be lighter.

Purchase of weanlings

Where differences in growth occur in early life these largely persist throughout life with little compensatory growth. Thus for example, if weanlings are 40 kg below target in autumn, at least 30 kg of this will remain to slaughter. Clearly, if this deficit is to be made up, the animals will have to be fed better or retained for longer. Alternatively, they could be slaughtered 30 kg lighter. This is the equivalent of about 16 kg carcass, the value of which is probably less than the initial difference of 40 kg liveweight.

Purchase of yearlings

As animals get older at purchase, less of their history can be ascertained as they may have had more than one previous owner. If yearlings are below their target weight, it may be because they were light as weanlings or because they performed poorly in the weanling to yearling period. If they were light as weanlings but performed normally afterwards then the situation outlined above for weanlings applies. In contrast, if all the difference in weight resulted from poor performance in the weanling to yearling stage then up to three quarter of this will be compensated for. In practice, light yearling weight is probably a combination of both light weanling weight and poor performance in the weanling to yearling stage. If for example yearlings are 60 kg below their target weight due to being 20 kg lighter as weanlings plus 40 kg less gain in the weanling to yearling period, then about 30 kg of this will be compensated for leaving an additional 30 kg which can only be made up either by better feeding or keeping the animals for longer. In many instances the best option might be to slaughter the animals 30 kg lighter. The value of the carcass weight (16 kg) difference would probably be less than that of the original 60 kg liveweight difference.

Purchase of stores

Where stores are purchased in spring at around two years of age for finishing at pasture, there is generally considerable compensatory growth potential in animals which are below their liveweight target. However, with the 30 month limit on slaughter age there may not be sufficient time to exploit this compensatory growth, so light stores will still be light at slaughter. Such animals may be under finished and suffer a price discount. Therefore, the purchase of light stores for finishing off pasture should only be considered where there is sufficient time to finish them adequately.

Where stores are purchased in autumn for finishing over the winter, light animals can be expected to show only modest compensatory growth. Therefore, the feeding level must be increased or the finishing period extended if the target slaughter weight is to be achieved. A further option, as in the other cases, would be to slaughter at a lighter weight. This would have fewer consequences for finish and carcass appearance than slaughter off pasture because of the greater fattening effect of winter finishing diets compared to pasture.

Rapid finishing

Where animals approaching the 30 month limit are still not finished, a period of rapid finishing on a high concentrate diet could be considered provided the increment of weight gain required is not excessive. For animals with reasonable compensatory growth potential (which should be the case if they have a low weight for age) the expected daily gains for various intervals during a finishing period are shown in Table 6. Rate of gain declines considerably with increasing length of finishing period. For the first 8 weeks quite good gains are achieved but after 16 weeks gains are low.

The periods required to put on varying increments of liveweight gain from 100 to 250 kg on animals fed on a high concentrate diet are shown in Table 7. Up to 100 kg liveweight gain can be achieved in 10 – 11 weeks and 150 kg can be achieved in about 17 weeks. Except in exceptional circumstances putting more than 150 kg liveweight gain on heavy animals finished on a high concentrate diet is unlikely to be economical. Animals finished on a high concentrate diet generally have a higher kill-out than animals finished on forage based diets. Such animals can therefore be slaughtered at a somewhat lower liveweight.

Slaughter age and carcass traits

After breed type, the main factor affecting carcass grades and other carcass traits is slaughter weight. If slaughter age must be lowered, at least some of the animals now slaughtered off pasture will have to be finished indoors at a younger age (assuming the present spring calving pattern continues). Where animals were finished indoors at 24 months rather than off pasture at 29 months at approximately the same slaughter weight, effects on carcass traits were small but generally in favour of indoor finishing (Table 8). Kill-out was about 10 g/kg higher for the animals finished indoors. Thus indoor finished animals can be slaughtered 10-15 kg lighter for the same carcass weight. Carcass conformation was marginally improved by indoor finishing and fat score was somewhat higher. However, more objective measures of fatness suggested that the difference in fatness was much greater than indicated by fat score. While increased fatness is rarely desirable the greater fatness of indoor finished animals could be beneficial in ensuring adequate finish in light carcasses.

Carcass traits at various carcass fat classes

There appears to be reluctance to slaughter earlier because of the consequences for other slaughter traits, which affect value. Carcass weights and liveweights at varying carcass fat classes are shown in Table 9. Clearly, as slaughter and carcass weights increase so does fat class and *vice versa*. On average carcass weights of early maturing, Friesian, continental dairy, and continental suckler steers change by about 40, 40, 50 and 55 kg per unit change in fat class. The corresponding liveweight changes are 65, 60, 75 and 80 kg.

In addition to the effects on fatness a change in slaughter weight would also have knock-on effects on kill-out proportion and carcass conformation. Kill-out proportion at the various fat classes is shown in Table 10. Per unit change in fat class, kill-out proportion changes by about 11, 14, 15 and 16 g/kg for early maturing, Friesian, continental dairy, and continental suckler steers, respectively. A more useful way of expressing it might be that for early maturing, Friesian, continental dairy, and continental suckler steers kill-out proportion changes by approximately 10 g/kg per 65, 43, 52 and 52 kg change in slaughter weight for the breed types as listed. The data shown in Tables 9 and 10 imply that change is linear. This is not so but it is difficult to find another way of describing the changes. For example, when animals are light and lean, kill-out increases rapidly with increasing weight. Thereafter, the rate of increase slows down.

Carcass grades vary widely between experiments and between groups of similar animals slaughtered at different times. This is particularly true for conformation making it difficult to estimate rates of change with changing carcass weight or fatness. Conformation class at the various fat classes is shown in Table 11. This can in turn be related to the weight and kill-out data in Tables 9 and 10. Conformation improves with increasing weight but as with kill-out the relationship is not linear. Most breed types fall into one of two conformation classes so once carcasses reach the higher of their two classes no amount of additional weight gain will bring about further improvement in conformation. For example, Friesians are predominantly O conformation and some can reach R if they are heavy and well finished but they can never become U. Similarly, continental sucklers are generally R when light and U when heavier but they rarely become E no matter what weight they are taken to. On average, conformation improves by one class per 160, 200, 190 and 180 kg increase in slaughter weight for the breed types as listed above.

Conclusions

For the foreseeable future animals over 30 months of age are unlikely to be considered prime beef and this will be reflected in price. All breed types available can be satisfactorily finished at less than 30 months (steers and heifers) and yield carcasses of acceptable weight and grades. Irrespective of breed type or source (dairy or suckler herds), animals born before March are probably best finished indoors at about 24 months of age (steers) or 21 months (heifers). Animals born later in spring can be finished at pasture and slaughtered at 27-28 months of age.

Where purchased animals are below their target weight for age they may express compensatory growth particularly at pasture, but the gap will not be entirely closed so they will either have to be fed better, retained for longer or slaughtered lighter. Considering that so many carcasses are overfat, the latter option may be the most appropriate. Where there is only a limited time period available before 30 months, rapid finishing on a high concentrate diet could be considered provided the liveweight gain increment required is not more than about 150 kg. Slaughter at a younger age/lighter weight will result in lower kill-out and carcass grade values. As slaughter weight decreases, kill-out, carcass fat class and carcass conformation class all decline but the changes are relatively modest.

Due to the seasonal pattern of calving (predominantly spring), there will be somewhat less finishing off pasture than heretofore. However, with good grassland management in the calf and yearling grazing seasons, there is no reason why the total proportion of gain from pasture should change. Earlier slaughter at lighter weight would generally be beneficial because carcasses would be less fat.

Table 1. Margins on a 40 ha farm from 24 and 24-30 month calf-to-beef systems and summer finishing

System	1	2	3
Slaughter age (mts)	24	24-30	30
No animals sold	68	56	180
LU/ha	1.68	1.59	2.0
Carcass (kg)	360	360 (30)+ 410 (26)++	390
Gross margin (£/ha)	1003	887	776
Net margin (£/ha)	719	608	571
Net margin + REPS (£/ha)	828	715	678
Net margin per animal (£)	487	511	511

All systems in REPS; LU = Livestock units (Caffrey, 2000)

+30 animals slaughtered at 24 months; ++26 animals slaughtered at 30 months.

Table 2. Seasonal distribution of calf births (%)

Month	Dairy+	Suckler	Total++
Jan/Feb	38.0	20.7	30.2
Mar/Apr	45.7	51.2	46.9
May/Jun	9.8	15.2	11.6
Jul/Aug	1.5	5.1	3.1
Sept/Oct	2.4	3.6	3.9
Nov/Dec	3.2	4.2	4.2
Feb/Apr	73.1	65.7	68.3

+Excludes cows for liquid milk production; ++Includes cows for liquid milk production.

Table 3. Target weights and weight gains for 24-month Friesian (FR)+ and continental x Friesian (CT) steers

Date	No. Days	Weight gain (kg/day)		Weight (kg)		Age (weeks)	System event
		FR	CT	FR	CT		
Mid March	-	-	-	45	50	-	Purchase
Mid May	60	0.65	0.65	85	90	8	To pasture
Mid November	185	0.80	0.80	230	235	35	To house
Late March	125	0.50	0.55	295	305	53	To pasture
Mid October	210	0.90	0.95	480	505	83	To house
Mid March	160	0.85	0.95	615	660	106	Slaughter
Overall	740	0.77	0.82	615	660		
Kill-out (g/kg)				520	545		
Carcass weight				320	360		

+Applicable to early maturing steers also.

Table 4. Target weights and weight gains for 24-month (steers) and 21 month (heifers) from the suckler herd (fl Continental)

Date	No. Days	Weight gain (kg/day)		Weight (kg)		Age (weeks)	System event
		Steers	Heifers	Steers	Heifers		
Mid March	-	-	-	48	43	-	Birth
Early November	240	1.15	1.05	320	290	34	To house
Early April	150	0.55	0.50	400	360	56	To pasture
Late October	205	0.95	-	580	-	85	To pasture
Late November	230	-	0.90	-	570	89	Slaughter+
Mid March	135	0.90	-	700	-	104	Slaughter
Overall	730	0.89	0.85	700	570		
Kill-out(g/kg)				564	544		
Carcass weight				395	310		

+Heifers finished on concentrates at pasture or indoors on silage + concentrates.

Table 5. Target weights and weight gains for late born suckler calves finished at 21 months (heifers) and 27 months (steers)

Date	No. days	Weight gain (kg/day)		Weight (kg)		Age (weeks)	System event
		Steers	Heifers	Steers	Heifers		
Mid May	0	-	-	48	43	-	Birth
Early November	180	1.10	1.00	250	220	26	To house
Early April	150	0.55	0.50	330	295	47	Turn-out
Early November	220	0.85	0.80	520	470	79	To house
Early April	150 (100)[+]	0.45	0.90	590	560	100 (93)[+]	Turn-out
Mid August	123	0.90	-	700	-	118	Slaughter
Overall	823 (658)	0.79	0.79	700	560		
Kill-out				557	536		
Carcass (kg)				390	300		

[+]Heifer finished for 100 days.

Table 6. Weight gain by period on a high concentrate diet

Days	0 to 56	56 to 112	112 to 168	168 +
Daily gain (kg)	1.4	1.2	0.9	0.5

Table 7. Time required to achieve varying increments of weight gain in animals finished on a high concentrate diet.

Gain required (kg)	100	150	200	250
Days on feed	74	117	176	276
Average daily gain (kg)	1.35	1.28	1.14	0.91

Table 8. Comparison of pasture and indoor finishing (CH x FR steers)

	Pasture	Indoor	Indoor as % pasture
Slaughter age (mts)	29	24	-
Slaughter weight (kg)	690	670	97
Kill-out (g/kg)	533	541	102
Carcass weight (kg)	367	362	99
Conformation	2.88	3.00	104
Fat score	3.61	3.74	104
Fat depth (mm)	9.2	14.3	155
Kidney + channel fat[+]	31	48	155

g/kg carcass

Table 9. Carcass and liveweights (kg) at various carcass fat classes

	Carcass weight (kg) at				Liveweight (kg) at			
Fat class	**3**	**4L**	**4H**	**5**	**3**	**4L**	**4H**	**5**
Breed type								
Early maturing	270	300	320	350	525	575	605	655
Friesian	290	320	340	370	575	625	650	695
Continental (dairy)	310	350	380	410	590	650	700	740
Continental (suckler)	320	360	400	430	595	660	715	755

Table 10. Kill-out proportion (g/kg) at various carcass fat classes

Fat class	**3**	**4L**	**4H**	**5**
Breed type				
Early maturing	514	522	529	534
Friesian	504	512	523	532
Continental dairy	525	538	543	554
Continental suckler	538	545	559	569

Table 11. Conformation class of steers at varying fat classes

Fat class	**3**	**4L**	**4H**	**5**
Breed type				
Early maturing	2.2	2.5	2.7	3.0
Friesian	1.8	2.1	2.2	2.4
Continental dairy	2.5	2.8	3.0	3.3
Continental suckler	2.8	3.1	3.4	3.7

The Irish beef industry - an alternative view

PHILIP FARRELLY
Agricultural Consultant, Navan Co. Meath

Introduction

Traditionally a large proportion of Irish beef has been disposed of through intervention or third country markets, rather than marketed on the lucrative European market. This has led to both the processors and producers receiving prices below the European average.

The Beef Task Force summarised the conclusions from a series of studies and made recommendations, which in turn were accepted in the Agri Food 2010 report. Funding for changes has been committed in the National Development Plan. However, it can be argued that the proposed solutions are based on a flawed analysis of the problems and if implemented, whilst leading to improvements at processing level, will greatly accelerate the decline in farmer numbers.

A solution can only be found by adopting a new paradigm for the industry. It must be accepted that there are three phases in the process. Production, processing & marketing. Traditionally slaughtering, processing and marketing have been carried out by the same people. This link must be broken. A new marketing company should be formed, preferably owned and funded by farmers. Farmers would then rear cattle and sell them at a pre-determined and agreed price to this company. This company would pay an agreed fee to a processor to slaughter and process the animals to the required standards. The marketing company would then market Irish beef in the affluent European market and distribute the profits to its shareholders.

This path would require a paradigm change for all involved in the industry. We would need to see the industry as an opportunity and as a challenge rather than a crisis. The potential rewards are large. Achieving European prices would earn the industry an extra £400 million at 1999 prices.

Mention beef and the word crises springs to mind. It is not just farmers who have problems, all the stake holders in the beef industry, the farmers, the processors, the butchers, the retailers, the consumers indeed the Government, all at the moment look in despair at the beef industry and wonder where the future lies. From a farmer's perspective the story gets worse and worse. Relative to the community and indeed to other farmers, beef farmers have been getting poorer and poorer. The point has now been reached where only a handful of full-time beef farmers remain in business.

The processing side of the business is also in crisis. Recent reports have drawn attention to the fact that meat processors operate a very low profit margin relative to other industries. Virtually no re-investment has occurred in the meat processing business in recent years. Given the low rate of re-investment in the industry there are real concerns as to whether Ireland could supply the sophisticated European markets even if we could access them. The butchering business is also in decline with the number of retail butchers falling on a yearly basis. If butchering was even moderately profitable this would not be the case

The large multiple supermarket chains which retail the majority of beef nowadays complain that their meat business is low margin and difficult. Consumers, for so long secure and content with the meat they ate, are now racked with doubts on safety and health grounds. These doubts are almost incapable of explanation on a rational examination.

Governments at national and EU level are becoming increasingly frustrated. After decades of pouring money into market support systems they now find the market still in total chaos with no end in sight to funding requirements. Worse still the very stability of Governments is being threatened by the BSE crisis with cabinet ministers losing their jobs as a result.

Looking for an answer

Despite its problems the beef industry is hugely important. Unfortunately, each sector blames the other for the problems. Farmers are accused of being inefficient, and careless about food safety and failing to respond to market demands. Processors have been accused of operating a cartel to keep prices down and of failing to market Irish beef adequately. Retailers are accused of profiteering and failing to respond to price changes at farm gate. Consumers are blamed for their fickleness and they in turn, blame everybody else on health and safety grounds.

Analysing the Problem

There is no scarcity of analysis of the problem. Research and investigation has been conducted by:

- The Food Industry Development group
- The McKenzie report
- The report of the Beef Task Force
- The report of the Independent Group into Anti-Competitive Practices in the Irish Beef Industry
- Teagasc
- An Bord Bia

Each report has accepted and endorsed the findings of its predecessor and in a sense they are summarised in the report of the Beef Task Force. This report in turn gets approval from the Agri Food 2010 document, and there are commitments to funding change in the National Development Plan.

Recommendations

The recommendations of the Beef Task Force are aspirational and artificial. They do not deal in the real world. They try to accommodate the interests of all participants when this is clearly impossible. Suggestions were put forward for rationalisation in the processing sector, which would not be tolerated in any other industry. Their recommendations on marketing are aspirational and artificial and again would not be tolerated in any other industry.

There is pain to be suffered but the Beef Task Force has attempted to avoid the pain.

Why the wrong Recipe

The Beef Task Force accepted the views of the McKenzie Report, which was commissioned by Enterprise Ireland. However, Enterprise Ireland is charged with increasing employment in indigenous Irish industry, therefore, its principle focus is on employment in downstream industries rather than on the interests of beef retailers, beef marketing or the farmer's perspective. It was no surprise that the Beef Task Force accepted the conclusions of the Food Industry Development Group since the members of the Beef Task Force are almost identical to the members of the Food Industry Development Group.

Similarly the views of Teagasc and Bord Bia were also accepted by the Beef Task Force, since both organisations are represented on the Task Force. From the moment the Department selected the membership of the Task Force the outcome was inevitable. The group comprised members of the Department itself, which has presided over the *status quo* for years, and representatives of the farm organisations, which meant that the report could not come down heavily against the farmers and had to placate their representatives. Representatives of the meat processors and the Irish meat association. A committee containing five high ranking meat men could not lay the blame at the door of the factories. Add in a representative from Enterprise Ireland and a representative from SIPTU and now you have the interests of jobs and the workers protected. Top off the committee with a representative from Bord Bia and you ensure the continuation of the *status quo* in relation to marketing and promotion, and the Teagasc representative will ensure that there are platitudes towards increased efficiency at farm level and the value of the advisory service.

As a result of the make up of the committee the end result was inevitable, the farmers could not be blamed, the processors could not be blamed; the Department could not be blamed; Bord Bia could not be blamed and Teagasc could not be blamed. However, that wasn't the only weakness, not only could nobody be blamed but nobody could be given responsibility to change the situation. Given the committee make up the *status quo* had to be protected. So the Task Force reached a compromise - we'll do a little bit of this, we'll do a little bit of that and then everything should be all right.

Flawed Assumptions

At the heart of the analysis of the problems of the industry there is a flawed assumption that a single solution can solve the problems of all the participants in the industry. This is not the case. A solution that will solve the farmer's problems may be ruinous for the processors. What will solve the problem for the processors may eliminate the majority of the farmers. For example, if farmers were to export their weanlings their business might become very profitable, but this would have disastrous consequences for the processors.

Where are the solutions?

If we want to maintain the industry in anything like its present shape, then it is necessary to develop markets for Irish beef. This will not be done under the present regime were traditionally beef processors have also been the beef marketers. In this role they have failed totally. Yes, some European markets have been developed, but for decades, the easy option of either intervention or latterly subsided third country markets has been relied upon. Intervention is now gone and the writing is on the wall for the third country markets. We must develop a new paradigm for the industry. To do this requires separation of the three distinct processes: -

Production
Slaughtering & Processing
Marketing

Production - this is a relatively efficient sector, which is adaptable, but can be improved. Beef can be produced at a profit, at a price ranging between 85-90p per pound depending on the season.

Slaughtering & Processing - whilst the slaughtering and processing industry is capable of handling the entire production from Irish farms, it is in need of rationalisation. The industry has a skilled labour force, storage, transport, chilling and freezing facilities, and has a well-established distribution network. With rationalisation and re-organisation there is no reason why the slaughtering and processing industry in Ireland couldn't be developed to be the most efficient in Europe.

Marketing - It is at marketing that the weakness exists in the Irish beef industry, and it is at marketing that we will continue to fail until we break the link between marketing and processing. Marketing must be established as an independent link in the chain. One model of this already exists in the Irish Dairy Board. In the past the size of a processors slaughtering capacity was the size of his marketing responsibilities. All of the reports identify the lack of commitment to long-term marketing and opportunism among the meat groups, together with cut-throat competition and rivalry as being major problems in the past. These problems will not go away. The structure of the industry with the processors having to compete against each other for raw material and again compete in the markets means that no one processor could possibly afford to invest the resources necessary to develop long term markets. It is not that the markets are not there; it is simply that the investment has not been made to develop them. If any other industry sector behaved in a similar fashion to the beef processing sector, they too would have similar problems. The drinks industry and the motor industry for example have fierce competition for market share but yet the manufacturers strictly adhere to codes of conduct on pricing and pricing agreements.

A marketing company could be very profitable and could achieve increased prices at wholesale and therefore at producer level.

The chain will then have three distinct links;

Production
Slaughtering & Processing
Marketing

Are we Winners or Losers?

From a positive perspective there is a tremendous opportunity awaiting the Irish beef industry. To avail of this opportunity does not require that we re-invent the wheel or sell something to the Europeans that they don't like. Nothing is being asked that hasn't been done before. What is required is that we sell more Irish beef. In 1995 (before the BSE crisis) we sold 70% of our beef in Europe, by 1999 this had reclined to 50%, but this reduction is against a backdrop of alternative easy third country markets being available. There is no choice. If we don't sell beef in Europe then we will not sell beef. The question really is, will we sell beef better through a single agency or do we leave it is the disjointed failed methods of the past?

Paths to achievement

What is required is the establishment of a marketing company preferably funded by farmers, which would take responsibility for marketing Irish beef. This company would commit major resources to marketing and promotional effort. Bord Bia's present budget for its entire operation is approximately £20million. It has responsibility for the entire food industry including beverages, pig meat, sheep meat and prepared meals along with beef. Out of this budget it is hard to imagine its marketing spend on beef could be greater than £5million. This is spread over the Irish and European market. If 7% of the wholesale value of Irish beef were allocated to marketing this would deliver a budget of £140million or a thirty-fold increase in marketing effort.

The steps

- Unity of purpose among farm organisations and a commitment from farmers to make a large equity investment in their own futures.
- Commitment of the Department of Agriculture in terms of equity, investment and annual support.
- Share capital launch to secure a sound capital base (an average investment of £1,000 per farmer involved in the cattle industry would yield £130,000,000).
- Recruit top class management and engage the services of Europe's brightest promotional and marketing expertise.
- Co-operate with Department of Agriculture and other agencies in enforcing the most rigorous quality and safety standards at all stages in the supply chain.
- Commit a minimum of 7% of wholesale sales to the marketing effort (£140million in 1999 terms).

Relationships between milk production, grass dry matter intake and grass digestion

JEAN LOUIS PEYRAUD, RÉMI DELAGARDE, LUC DELABY
Joint Research Unit INRA-ENSAR on Dairy Production,
Domaine de la prise, 35590 St Gilles, France

Introduction

With the advent of milk quotas, the necessity to take account of environmental concerns and current changes in agricultural policy (GATT proposals), limitations have been imposed on intensive production systems. Further changes will continue to reduce the level of protection enjoyed by EU countries, and will reinforce environmental constraints. In the future, utilisation of grass by grazing will form the basis of sustainable dairying systems, especially in western Europe where grass grows regularly from spring to autumn. Grazing is the cheapest source of nutrition for dairy cows, thus allowing an increased efficiency per litre of milk. Grazing also contributes to preservation of the rural landscape and gives a good image of dairy products.

Full exploitation of the grazed grass requires the development of grazing systems designed to maximise daily herbage intake per cow and to improve the efficiency of nutrient use through the provision of supplementary feeds. Since the original work of Mott (1960), a large number of studies have highlighted the effect of grazing management and amount of supplementary feeds upon performances per animal and per unit area. However, most of these studies have been based on systems designed to achieve maximum milk yield per unit area, accompanied by increased use of energy concentrates. The challenge is now to reduce inputs by examining opportunities to improve grass intake per cow while maintaining high quality swards over the grazing season. To achieve this objective, we need to describe the input/output response curves that should be used to evaluate the optimal supply according to the current price.

Milk production is largely dependent upon the factors controlling herbage intake and ruminant digestion. The factors involved include animal characteristics themselves, and the nutritive value and physical characteristics of the swards. In practice, grazing management and grass production techniques can manipulate these latter two factors. The aim of this paper is to review recent advances on the effect of these sources of variations, with particular emphasis on opportunities to increase grass intake per cow, grazing good quality pastures and to describe the response curves.

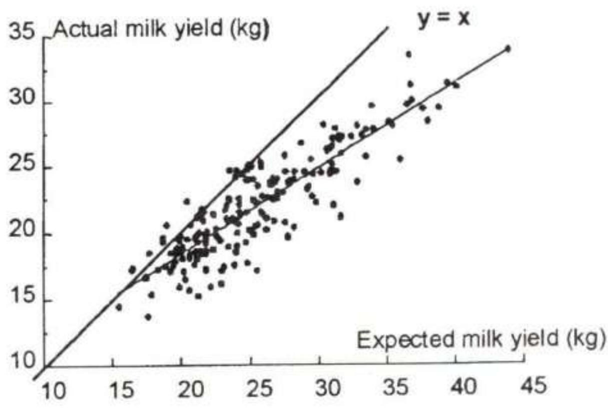
Animal factors affecting intake and production at grazing without supplements

Delaby *et al.*, (1999a and 2001) have examined the performances of unsupplemented grazing cows (Figure 1) over 187 lactations. They showed that actual milk yield (aMY) in spring grazing cows (April to early July) averages 22.2 kg when no concentrate was delivered, but there were large differences between cows, the range being 10 kg within primiparous and 17 kg within multiparous cows. The cow potential primarily affects these differences. The authors propose estimating cow potential using the concept of expected milk yield (eMY). The eMY parameter is calculated as the reference milk yield at turnout (early April) when cows were fed *ad libitum* with maize silage and grass, corrected for the length of the experiment assuming a weekly persistency of 0.98. The relationship between aMY and eMY is linear;

$$aMY = 0.25\ DHA + 0.65\ eMY + D;\ n=187;\ rsd = 1.71;\ r^2 = 0.83 \quad \text{(equation 1)}$$

where DHA is daily herbage allowance at 5 cm above ground level in kg DM $cow^{-1}\ d^{-1}$ and D = +1.3 for multiparous and +0.6 for primiparous cows. This relationship shows that beyond 15 kg of milk, cows are able to produce 0.65 of each kg of expected milk in addition above 15 kg. This means that a cow producing 40 kg of milk at turnout (i.e. 35 kg eMY during 12 spring weeks) is able to produce around 28 kg with no supplements at spring grazing and illustrates the potential to achieve quite high performance levels at pasture although there is not a full exploitation of the genetic merit. However the difference between the expected and actual milk yield reflects the shortfall between the theoretical requirements of the cows and the energy inputs allowed by herbage alone. This shortfall increases from 4 kg in cows with 25 kg of expected milk to 9 kg in cows with 45 kg of expected milk. Kolver and Muller (1997) have also pointed out a major reduction in milk yield in cows with high potential that were fed with grass only.

Figure 1: Milk yield at grazing without supplementation in relation to milk potential (after Delaby *et al.*, 1999)



Daily Herbage DM intake (DHI) averages 11 kg for dry cows (Delagarde and Peyraud, unpublished), which is higher than the maintenance requirement. DHI is 3 to 5 kg higher in milking cows than in dry cows (Hodgson and Jamieson, 1981; Gibb *et al.*, 1999, Delagarde *et al.*, unpublished). High yielding cows have a greater nutrient demand, and this is reflected in increased grass intake, with incremental increases in DHI averaging 260 g DM kg eMY^{-1} (Caird and Holmes, 1986; Peyraud *et al.*, 1996 b, Christie *et al.*, 2000; Delagarde *et al.*, 2000). This additional increase in intake represents about two thirds of the net energy (NE) requirement for 1 kg of fat-corrected milk when the digestibility of the grass is higher than 0.75. This is in reasonable agreement with the observed milk responses in Figure 1. Levels of intake up to 20 kg DM day^{-1}, which allows a production of 30 - 32 kg milk, can be reached during a few weeks in the spring when both the digestibility of sward and herbage allowance are high. The partial regression coefficient between herbage intake and milk yield is higher (400 to 500 g kg^{-1} milk) when experimental milk yield was used (Stakelum and Connelly, 1987; Butler *et al.*, submitted; Peyraud, unpublished) reflecting herbage intake limits to milk yield at grazing.

Grazing time increases between dry and lactating cows from 5 to 8 min kg $milk^{-1}$, (Brumby, 1959; Journet and Demarquilly, 1979; Delagarde and Peyraud, unpublished). However within lactating cows rotationally grazed, increases in herbage intake are mostly mediated through higher rates of intake, grazing time tending to reach a plateau at 10 h d^{-1} (Rook and Huckle, 1996; Delagarde, 1997; O'Connell *et al.*, 2000). This clearly indicates that high-producing animals are able to express a higher motivation and a more aggressive appetite at grazing. This also points out the necessity to offer easily harvestable grass. Whether higher intake rate is due to a faster biting rate (O'Connell *et al.*, 2000) or to a larger intake per bite as suggested by the studies of Fuerst-Waltl *et al.*, (1997) and Butler *et al.*, (submitted) remains unclear.

The eMY parameter depends on the genetic merit of the cow and the number of days in milk. DHI appears to be mainly governed by the peak of milk production with incremental increases averaging 180 g DM/kg milk at the peak (Peyraud *et al.*, 1998; Delagarde *et al.*, 2000) but DHI is poorly related to the stage of lactation after the second month of lactation (Caird and Holmes, 1986; Peyraud *et al.*, 1998; Delagarde *et al.*, 2000). With first lactating cows, Butler *et al.*, (in press) reported a significant increase of grass intake with the number of days in lactation (20 g DM day^{-1}). For spring calving cows, herbage intake increases from about 12 kg DM at 10 days of lactation to 16 kg at the end of the first month (Peyraud, unpublished), which is not sufficient to meet energy and protein requirements. Moreover the animal's capacity to increase intake at the beginning of the lactation appears to be largely influenced by the sward conditions. DHI increases by 1.0 to 1.5 kg DM 100 kg^{-1} of body live weight (Peyraud *et al.*, 1996 b and unpublished), which is similar to the incremental increase reported for cattle differing in size (Zoby and Holmes, 1983). This is mediated by an increase in the rate of intake of 3 g DM min^{-1} per 100 kg LW whereas grazing time decreases (- 40 min per 100 kg LW, Delagarde, 1997) as the size of the animal increases. This also appears to be the case between growing cattle differing in age and live weight when the grazing time decreases by 30 min per 100 kg LW (Zoby and Holmes, 1983). Intake is decreased by 2.5 kg OM day^{-1} in Normand cows compared with Holstein cows. The difference is mainly explained by the difference in milk yield (Delaby *et al.*, 1999b) and it does not appear to be a breed effect *per se*.

Sward factors affecting intake and milk production at grazing

It has been recognized for a long time that herbage digestibility is an indirect predictor of the main characteristics of plant material that determine filling effect in the rumen (e.g. rate of digestion, rate of passage) and thus partly determines voluntary dry matter intake (VDMI in kg day^{-1}) in housed animal (Demarquilly and Jarrige, 1971). At grazing the situation is more complex. Changes in sward digestibility are most often associated with several sward structural changes such as mass and height, content and distribution of the different morphological components within the canopy. The effect of grass digestibility and quantity of easily harvestable material are operating in the same time in controlling DHI. This lead to difficulties in quantifying the relative effect of the physical constraints to prehending grass, and rumen fill in controlling herbage intake. Moreover grazing cattle generally select a diet of higher digestibility than the total available sward.

Nutritional factors

In housed animal, provided grass is delivered in a vegetative stage VDMI of the main grass species does not vary to any large extent (Table 1). At equal digestibility, VDMI of legumes is 5 to 10 % greater than that of grasses (INRA 1989). Prior to entering the reproductive stage VDMI declines only slightly (0.15 to 0.20 kg day^{-1} per week) with the age of regrowth (due to the ratio between green leaves and stem not changing significantly. However, the rate of decline increases significantly after the beginning of the heading stage. Between early heading and end of flowering VDMI declines by 0.17 kg day^{-1} per unit of digestibility. The rate of decline is faster for Cocksfoot and Bromegrass than for perennial ryegrass and fescue. The effect of digestibility is less for legumes than for pure grasses.

Table 1. Digestibility and Voluntary Dry Matter Intake (VDMI) by a standard dairy cow (25 kg of milk, 600 kg Live Weight) of the main forage species at a vegetative stage of regrowth

Species	Digestibility	VDMI (kg DM day^{-1})
Gramineous		
Bromegrass	0.790	17.4
Cocksfoot	0.725	17.6
Meadow fescue	0.780	17.9
Tall fescue	0.717	17.0
Timothy	0.754	16.8
Perennial ryegrass	0.783	17.1
Italian ryegrass	0.778	17.4
Légumes		
White clover	0.792	18.0
Red clover	0.767	18.4

At grazing, Curran and Holmes (1970) failed to show from multiple regression analysis a significant effect of digestibility on DHI in dairy cows (d > 0.75). However Peyraud *et al.*, (1996b) and Ferrer-Cazcarra (1995) have reported a small positive effect with incremental increase of DHI ranging from 0.1 - 0.2 kg per unit increase in pepsine-cellulase digestibility. In Ireland, a set of experiments has shown large effects of sward digestibility upon DHI (-0.5 kg DM per unit digestibility) and milk production in summer (Stakelum and O'Donnovan, 1998). However, in these trials changes in digestibility were probably associated with large modifications of the sward structure as the different levels of digestibility were created by different grazing pressure in early spring.

Direct comparisons of grazed grass species have been extremely rare in dairy cows. The original work of Demarquilly (1963) showed that there were some reproducible variations in milk yield when cows grazed different grass and legumes species. The comparisons generally confirmed data obtained from indoor experiments, although differencees were sometimes larger (cumulative effects of digestibility and structure?). Greenhalgh and Reid (1969) reported that DHI and milk yield were both reduced by 1 to 2 kg day^{-1} when cows were grazed on cocksfoot rather than on perennial ryegrass swards. As a consequence, an extra 2 kg of concentrate must be provided to maintain milk yield on cocksfoot plots (Hoden and Peyraud, unpublished). Herbage intake by sheep are higher on monocultures of legumes than on grasses (Orr *et al.*, 1995). Delagarde *et al.*, (unpublished) have recently observed higher DHI on a mixed ryegrass/white clover sward compared with a pure grass sward (13.3 vs 11.4 kg DM day^{-1}) while the pepsine-cellulase digestibility was lower on ryegrass (0.75 vs 0.72). Several studies have shown that milk production is higher within a mixed sward compared with pure perennial ryegrass (Murdock *et al.*, 1960; Thomson *et al.*, 1985; Wilkins *et al.*, 1994 and 1995), the differences increasing with the clover content. The mixed ryegrass/white clover swards should be seriously considered as an alternative option to pure grasses swards with the expected reduction in the use of N fertiliser.

DHI of grazed ryegrass falls by 2.2 kg day^{-1} between the vegetative and the reproductive stage (Greenhalgh *et al.*, 1966). Age of regrowth is also reported to effect DHI in vegetative swards. Parga *et al.*, (unpublished) have shown a 1.5 kg DM fall in DHI between 20 and 40 days of regrowth. The detrimental effect of age of regrowth on intake is worsened in terms of inputs of nutrients by the reduction of the nutritive value of grasses (INRA, 1989). Between 28 and 50 days, digestibility (0.80 to 0.75) and content of protein flowing into the duodenum (154 to 110 g kg DM^{-1}) decrease for perennial ryegrass whereas they remain practically unchanged for white clover (0.80 and 180 g kg DM^{-1}) (Peyraud, 1993; Mambrini and Peyraud, 1994). Again, mixed swards appear to be an interesting alternative option allowing more flexibility in grazing management.

The DM content of herbage can affect herbage intake. Studies with housed cows showed that low DM content reduces herbage intake at a rate of 1 kg per 40 g kg^{-1} fall in DM content below a critical value of 180 g kg^{-1} (Verite and Journet, 1970). The mechanism is not yet completely understood. In recent studies conducted in Rennes (Cabrera *et al.*, unpublished) increasing DM content from 19 to 26 % by a soft drying of fresh grass increased DM intake from 17.9 to 18.9 kg day^{-1} whereas diluting DM content by soaking fresh grass into a water bath did not decrease herbage DM intake irrespective of whether the grass was previously dried or not. This suggests that internal water is more important than external water in regulating intake. High rainfall has also been shown to adversely affect intake by cattle (Butris and Phillips, 1987). Besides the effect of internal water content, the herbage surface water and/or soil contamination might also reduce the palatability of the herbage at grazing.

A shortage of protein is unlikely to arrive when cows are grazing good quality grass, since pasture has a high crude protein content. However, a shortage of protein may arise when the level of N fertilisation is reduced, when stage of maturity increases or during dry summers. Reduction in protein content below 12 % DM has led to a fall in herbage intake (2 kg DM day^{-1}, Delagarde *et al.*, 1997). Reduced herbage intake is mostly mediated through a shortage of degradable protein and/or metabolisable protein since feeding supplement rich in protected protein increases grass intake up to the control level (Delagarde *et al.*, 1997 and 1999). The threshold value is around 14% protein (Peyraud, 2000).

Grass availability

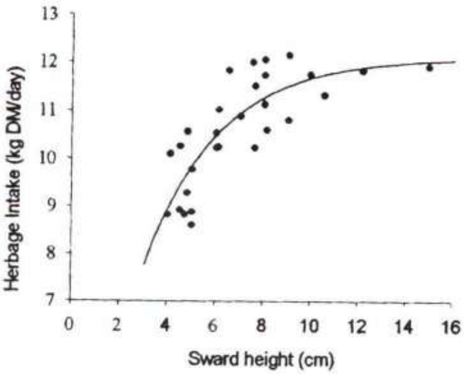
The three main factors affecting DHI at grazing are the intake capacity of the animal, the VDMI of the forage and the physical characteristics of the sward canopy which determines the quantity of harvestable material. Wade (1991) defines herbage availability as the relative ease or difficulty with which herbage can be harvested by the grazing animal. The availability of grass is a complex parameter, which takes account of qualitative and quantitative aspects of the sward, the nutritive value of the grass and the intake capacity and size of the animal, and the area allocated by the farmer. Numerous studies have focused upon the relationships between sward structure and intake per bite assuming an overriding importance of intake per bite in driving daily herbage intake. However, there is surprisingly little data to quantify the effect of sward structural characteristics known to influence the bite weight upon daily intake.

Under a continuous stocking situation, the area offered to cows is large, sward height is constant, then herbage availability is a direct function of the sward state. DHI increases asymptotically with sward mass and/or sward height (SH) (Le Du 1980). From a comprehensive review, Delagarde *et al.,* (2001, Figure 2) have obtained the relationship:

$$DHI = 12.1\ (1 - e^{-0.34\ SH})$$

This shows maximum intake for SH averaging 9 - 10 cm, and DHI decreasing rapidly for SH below 7 cm. These data were obtained with low producing animals and the threshold height to reach the plateau might be higher for high producing cows. Intake per bite and rate of intake are positively related to sward height. Animals increase their grazing time as a compensating response to a decline in the rate of intake, but compensation is seldom adequate to prevent a fall in daily intake on particularly short swards (Hodgson, 1986).

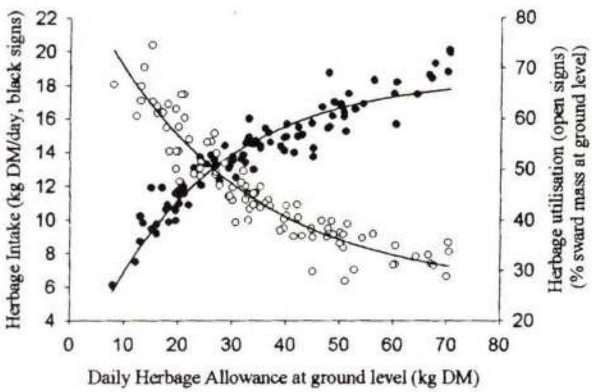
Figure 2. Influence of sward height on DHI in set stocked dairy cows (Delagarde *et al.*, 2001).



Under rotational grazing the area offered to the cow is limited and the animals are forced to graze into deeper layers of the sward, which results in a more complete depletion of the canopy. The process takes place in one day when fresh pasture is allocated daily (strip grazing) or during several days when a paddock is offered for several days (simplified rotational grazing) but the concept is the same. Herbage availability is firstly defined in term of daily herbage allowance (DHA). DHA is defined as the weight of herbage cut above a sampling height and allowed per cow per day (Greenhalgh *et al.*, 1966). It is important to bear in mind that DHA is a combination of the amount of grass per ha and the offered area, which is allocated by the farmer (either as an area offered each day or a residency time in a paddock). DHA is more often estimated at ground level or at a cutting height of 4 to 5 cm assuming that the material below that height is not available for the animal. A number of studies have demonstrated a strong curvilinear relationship between DHA and DHI (Greenhalgh *et al.*, 1966; Combellas and Hodgson, 1979; Peyraud *et al.*, 1996b). From a comprehensive review of the literature Delagarde *et al.*, (2001, Figure 3) have obtained the following relationship:-

$DHI = 18.4\ (1- e^{-0.0466\ DHA})$; $n = 92$; $r^2 = 0.87$; rsd = 0,99 (equation 2).

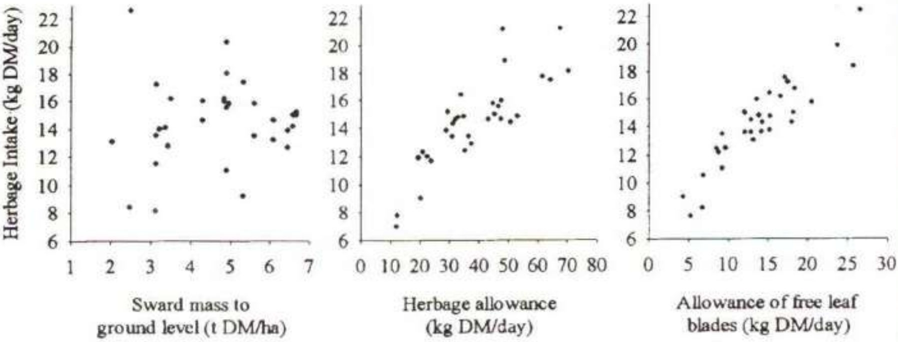
Figure 3. Influence of DHA on DHI in rotationally grazed dairy cows (Delagarde *et al.*, 2001)



According to the relationships, DHI reaches a plateau corresponding to the intake capacity of the cow for high DHA, which also corresponds to an inefficient utilisation of the sward and high post-grazing sward height. Conversely for DHA ranging between 30 to 40 kg DM (corresponding to normal grazing practices) the cows do not satisfy their appetite (DHI = 80% of the intake capacity). This explains why the response to supplementary concentrate can be high for high producing cows at grazing (see below). When considering DHA above 5 cm, Peyraud *et al.*, (1996) observed that with vegetative perennial ryegrass swards, an average increase in DHI of 0.27 kg DM per kg increase in DHA when DHA ranges between 12 to 17 kg day^{-1}, and a much smaller increase (+ 0.05 kg DM day^{-1}) as DHA increases above 20 kg day^{-1}. Milk yield increases by 0.25 kg day^{-1} per kg increase in herbage allowance over the same range of variation (see equation 1).

The response of DHI to DHA will depend on the cow requirement. When DHA increased from 12 to 18 kg, DHI did not vary for dry cows but increases (+ 2 kg) for high yielding cows (Delagarde and Peyraud, unpublished). Recent studies conducted at Moorepark with first lactating cows (Stakelum and O'Donovan, 2000) clearly show high genetic merit cows require higher DHA than low genetic merit cows. For a given allowance, grass availability might also be altered by the structure of the sward. This firstly raises the question of the effect of pre-grazing sward height/mass on intake. However, because the animals are forced to graze in the deep horizons, herbage intake might not be directly related to pre-grazing sward height/mass as it was described in continuous stocking (Figure 4). Stakelum (1986a) observed that DHI increased when herbage mass increased from 2.8 and 3.5 t DM ha^{-1}. Conversely, for higher levels of herbage mass, Parga *et al.*, (unpublished) have reported a linear decrease in DHI (-0.8 kg t^{-1} DM ha^{-1}) when cows grazed more mature vegetative regrowths (similar digestibility 0.77) between 4.3 and 6.1 t DM ha^{-1}. Combellas and Hodgson (1979) also found a slight decrease in herbage intake between 4.3 and 5.0 t DM ha^{-1}. Therefore, DHI may increase with increasing pre-grazing sward height/mass, reflecting a more favourable spatial distribution of the herbage in relation to ease of prehension as it is described in continuous stocking. On tall swards, other limiting factors may have a negative effect on daily intake. On a normal range of DHA, there might be an optimal range of pre-grazing sward height between 10 to 14 cm (rising plate meter).

Figure 4. Influence of sward mass, herbage allowance and allowance of green leave on DHI (after Hoogendoorn *et al.*, 1992; Wales *et al.*, 1999, Parga *et al.*, 2000 and unpublished; Delagarde *et al.*, unpublished)



On rotational grazing, because sward height will decline during the grazing down process as a function of DHA, the herbage availability is mostly determined by plant structure at the base of the sward, when the animal ceases to eat. In vegetative swards, the grass leaf consists of free leaf blade in the upper part of the sward and a leaf sheath at the bottom of the sward (pseudostem). Wade *et al.*, (1989 and 1995) first concluded that herbage availability varied not only with herbage height but also with the height of free leaf blades upon the pseudostem. This was based on the study of the grazing down process in rotationally grazed paddocks (Table 2). The swards were initially tall in three paddocks and small in three other paddocks. Intake and milk yield started falling when grazing reached higher heights in initially tall swards than in initially small swards, but milk yield and intake started to decline when the free leaf lamina was approximately 55 mm for the two types of swards.

Table 2. Relationship between cow performance and extended height of grazed tillers during grazing a five-day paddock (after Wade *et al.*, 1989 and 1995).

Day in paddock		1	2	3	4	5
Herbage intake (% day^{-1})		100	100	97	92	89
Milk yield (% day^{-1})		100	99	92	80	79
Extended tiller height (mm)						
	Short sward [(1)]	154	130	116	98	90
	Long sward	228	179	147	120	107
Height of free leaf blade (mm)						
	Short sward	99	72	55	43	36
	Long sward	136	91	60	43	29

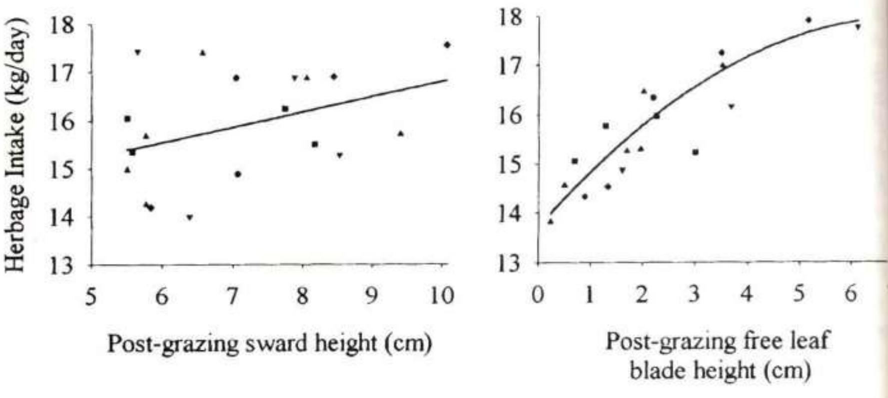
[(1)]: pregrazing height = 240 mm for short sward and 350 mm for long sward

The positive effect of a high proportion of free leaf blades in deep layers was further demonstrated by Parga *et al.*, (2000). These authors prepared two contrasting swards by different cutting regime before measurements. The swards differed by the proportion of green leaf blades below 15 cm (namely 39 *versus* 49%) but had the same amount of leaf blades above 15 cm and similar pre-grazing height (12.5 cm). At high DHA, DHI was similar in both swards, but when DHA decreased from 18 to 13 kg DM, DHI was less affected on leafy than on control swards. From a compilation of several experiments (Figure 4) it is clear that the allowance of free leaf blades is a better predictor of DHI than DHA thus confirming that pseudostems may act as a barrier to controlling intake. Increasing leaf blade mass at the bottom of the sward by appropriate grazing management or varietal selection may play a major role in increasing herbage intake while maintaining a low residual sward height.

In practice, these results suggest that DHI is not precisely related to post-grazing sward height (generally measured with a plate meter) when changes in sward structure were imposed. This was investigated at Rennes with 6 grazing experiments where different sward structures were compared at two levels of DHA (Delagarde and Peyraud, 2001). Post-grazing sward height increased with DHA, but for a given DHA, it was positively related to the pre-grazing sward height. Variations in DHI were predicted more accurately from the height of the residual free leaf blade upon pseudostem (Figure 5) than from post-grazing sward height. DHI decreases rapidly when height of the free leaf blades is below 4 cm in spite of possible variations in the post-grazing sward height. For example DHI can be dramatically reduced with a post-grazing height higher than 8 cm when cows graze plots with long pre-grazing pseudostem. This may occur on regrowths following a lax grazing in the previous rotation or with early heading varieties grazed in late spring.

Figure 5. Relationship between post-grazing height and DHI (Delagarde and Peyraud, 2001)

Peyraud, 2001)



Changing the proportion of leaf blade to pseudostem also affects the ruminal fermentation pattern, as leaf blades are highly fermentable. Parga *et al.*, (2000) and Delagarde *et al.*, (unpublished) have observed a lower pH (6.2 vs 6.0), a lower proportion of acetate (58.9 vs 62.3) and a higher proportion of propionate (23.1 vs 21.4) in the rumen of cows having access to leafy swards (42 vs 35 % leaf blades). This has led to a lower fat content in milk (36.6 *vs* 37.9 g kg^{-1}). The allowed quantity of leaf bladesdirectly affects ruminal pH and the ruminal fermentation pattern as shown in Figure 6, which summarises 3 trials in which allowance of leaf blades was controlled by manipulating the morphological composition of the sward and DHA; the higher the allowance the lower ruminal pH, and the acetate to propionate ratio.

Figure 6. The influence of allowance of free leaf blade on ruminal fermentation

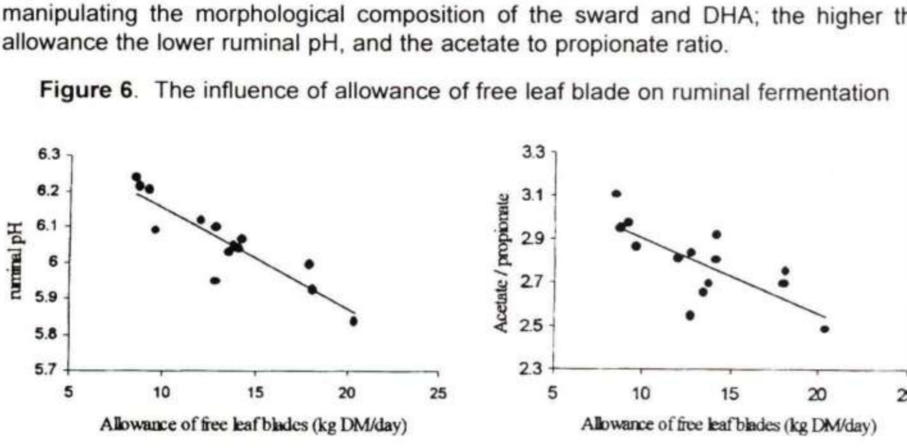
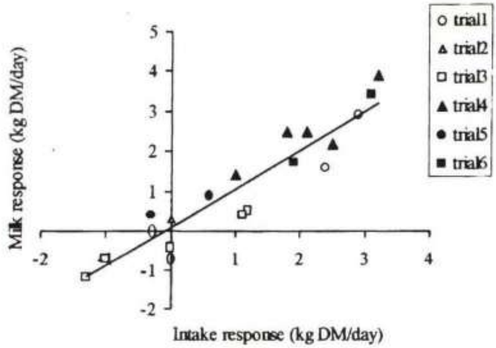


Figure 7 outlines the relationship between DHI response and milk response when DHI varies with grass availability. The data are taken from the set of 6 experiments conducted at Rennes. It is clear that responses of DHI and milk yield are closely related with each variation of 1 kg of DHI resulting in a 1 kg variation in milk yield. This slope is in good agreement with the marginal response of milk yield to variation in energy intake for cows that are fed slightly under requirement (INRA 1989). The figure also show that grazing management which results in different DHI will lead directly to an increase in animal performance. A short-term effect of 2 to 3 kg of milk can be expected.

Figure 7. Relationship between variations in DHI and milk yield when DHI is affected by the availability of grass.



The objective of grazing is to control the cumulative effects of the practices of grazing management on the sward structure over successive rotations. It has been shown that large increases in DHA in early season will result in a deterioration of sward quality in mid and late season. Mayne *et al.*, (1988); Hoogendoorn *et al.*, (1992); Fisher *et al.*, 1995, and Stakelum and O'Donovan (1998) have shown an increase in the proportion of stem and dead material, and a sharp reduction in herbage digestibility, DHI and milk yield in subsequent grazing rotations following lax grazing in early season. From a practical point of view, the room for manoeuvre is not very large. Hoden *et al.*, (1991) and Delaby *et al.*, (1999b) found that DHI can be increased by 1.5 kg DM cow^{-1} per day when increasing post-grazing sward height by 1 cm in spring without noticeable effects on sward quality late in the season. Beyond these values, alternative strategies must be adopted to utilise residual herbage to a degree commensurate with maintaining sustainable high quality swards over the grazing season. One possible alternative is to prepare leafy swards by grazing very early in spring with a group of heifers or sheep.

Supplementation at grazing

Offering concentrate feed has the objective of increasing total energy intake and animal performances but the extent of the responses will depend to what extent supplementary feeds affects herbage intake. When good responses were obtained, feeding concentrates is a powerful tool for controlling animal performance while ensuring a good grazing management.

Intake and Milk response to incremental amounts of supplements

Following the reviews of Journet and Demarquilly (1979); Leaver *et al.*, (1985) and Mayne (1991), it was generally accepted that concentrates were not used very efficiently by grazing dairy cows; average responses were 0.4 to 0.6 kg milk per kg (DM) from concentrate, mainly because feeding concentrate generally reduces DHI. Substitution rate (kg reduction in DHI per kg increase in concentrate DM intake) averaged 0.5 to 0.6. From two comprehensive reviews of the literature it has recently been shown that the efficiency of supplementation (0.6 ± 0.5, n = 141; Delaby and Peyraud, unpublished) and substitution rate (0.4 ± 0.3; n = 57; Delagarde and Peyraud, unpublished) are quite variable, indicating high responses can be achieved in some circumstances. Indeed, overall efficiencies close to, or higher than 1.0 kg of milk per kg DM concentrate were recently reported when low or moderate amounts of concentrate are provided to cows producing more than 25 kg milk at turnout (Table 3). It is probable these higher responses are related to the genetic merit of the cow which has increased appreciably since the earlier reviews, whereas DHA was not increased in order to control the level of post-grazing sward height.

Milk response to concentrate tends to decrease with increasing concentrate allowance (Table 3), but this effect seems to be moderate, providing concentrate allowance does not exceed 6 kg day^{-1}. The marginal efficiency (from which depends the economic returns) slightly decreases when sward limitations are minimised and/or with cows of moderate genetic merit. Delaby *et al.*, (2001) reported that marginal efficiency hardly decreased between 4 to 6 kg concentrate in slightly restricted grazing conditions with cows producing 30 kg of milk at turnout. A marginal efficiency greater than 0.6 was recently reported between 5 and 10 kg of concentrate for cows producing more than 35 kg milk at turnout (Sayers *et al.*, 2000). In the range of 2 to 6 kg day^{-1}, the amount of concentrate has no consistent effect on the substitution rate (Figure 5). Several experiments also failed to observe a consistent effect of increasing amounts of concentrate on substitution, (Meijs and Hoekstra, 1984; Kibon and Holmes, 1984; Opatpatanakit *et al.*, 1993) probably because high producing dairy cows rarely approach their intake capacity under grazing conditions (see Figure 3). Indeed, the substitution rate increases slightly with the amount of concentrate (Meijs, 1981; Hijink *et al.*, 1982) when unrestricted fresh grasses are fed indoors. At grazing, the reduction in herbage intake is essentially mediated by a reduction of 10 - 20 min per kg concentrate DM in time spent grazing (Combellas *et al.*, 1979; Kibon and Holmes 1987; Delagarde, unpublished).

Table 3. Effect of the amount of concentrate on milk response to concentrate supplements

Concentrate (kg DM day^{-1})			Global Efficiency (kg milk kg^{-1} concentrate)		Marginal efficiency	
C	M	H	0 to M	0 to H	M to H	Authors
0.9	2.6	4.3	0.8	0.5	0.2	Meijs and Hoekstra (1984)
0	1.8	3.5	1.4	0.9	0.4	Wilkins *et al.*, (1994)
0	1.8	3.6	0.9	0.7	0.6	O'Brien *et al.*, (1996)
0	1.8	3.6	1.3	0.9	0.5	Delaby and Peyraud (1997)
0	1.8	3.6	0.7	0.6	0.5	Dillon *et al.*, (1997)
0	3.4	6.7	0.9	0.8	0.7	Robaina *et al.*, (1998)
0	2.7	5.4	1.1	1.0	1.0	Delaby *et al.*, (2001)

C: control, M: medium, H high level of concentrate

Feeding moderate amounts of concentrate also linearly increases protein content in milk (+ 0.25 g kg^{-1} per kg of concentrate DM) but decreases milk fat content (- 0.6 g kg^{-1} per kg concentrate DM) (Delaby *et al.*, 2001). This is primarily due to a dilution effect on milk fat, which increases less rapidly than milk yield. It may also be a consequence of the rumen fermentation pattern because the acetic to propionic ratio in the rumen decreased in supplemented cows (Delagarde *et al.*, 1999 and unpublished). Feeding concentrate always increases body liveweight gain (60 g kg^{-1}, Delaby *et al.*, 2001). A part of the extra amount of energy supplied by concentrate supplementation is used to improve body weight and body condition score during the grazing season. This may also explain the improvement of the reproductive performances pointed out by Murphy and Fitzgerald (1998) when cows are supplemented.

Interaction between supplementation and grazing conditions

DHA has been recognised for a long time as a major factor affecting the substitution between grass and concentrate (Meijs and Hoeskstra 1984; Stakelum 1986a; b; c; Kibon and Holmes, 1987; Grainger and Mathews, 1989). From the analysis of 48 grazing experiments, Delagarde and Peyraud (unpublished) have demonstrated that the substitution rate (SR) between grass and concentrate is poorly related to the level of concentrate but is primarily a function of the net energy balance (EB in MJ day^{-1}) of the unsupplemented cows (SR = 0.32 + 0.10 EB, rsd = 0.19; Figure 8) as previously shown for conserved forages (Faverdin *et al.*, 1991). According to this relationship, the lower the energy balance the lower the substitution rate. The substitution rate is only 0.1 when energy needs are far from being covered from grass only (EB = -21 MJ or - 3 UFL) and increases up to 0.6 when sward limitations are minimised (EB = 28 MJ or 4 UFL). Assuming EB must be zero or slightly positive in the long term because cows adjust their milk yield (see Figure 1), SR should average 0.3 - 0.4 in normal grazing conditions. This is a rather low value, which explains recently reported high milk response to supplementation.

In a similar way, the efficiency of supplementation appears to be closely related to the proportion of requirement that is met from grass alone. In a comprehensive review, Delaby and Peyraud (unpublished) characterised the severity of the grazing conditions in 95 experiments by calculating the difference between actual milk yield of unsupplemented cows and their expected milk yield (eMY), assuming that the greater the difference between actual and expected milk yield (e.g. eMY-aMY for unsupplemented cows) the more adverse the grazing conditions with respect to animal demand. Response of milk yield to increasing levels of concentrate was linear but highly variable (Figure 9). The precision of the prediction sharply increased when grazing conditions are taken into account. The efficiency of supplementation is only 0.3 when energy needs are met from grass alone but reaches 0.9 when pasture intake is restricted. This principle has also been demonstrated in cows fed indoors with fresh grass. Stockdale and Trigg (1989) reported a marginal response of 1.8 kg milk per kg DM concentrate when cows consumed 6.8 kg of pasture DM each day and the response dropped to 0.6 when cows consumed 11.6 kg DM of pasture.

Figure 8. Effect of the level of supplementation and net energy balance on the substitution rate

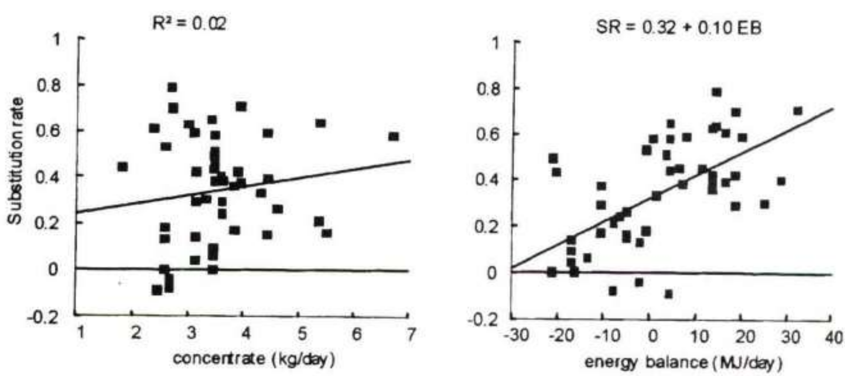
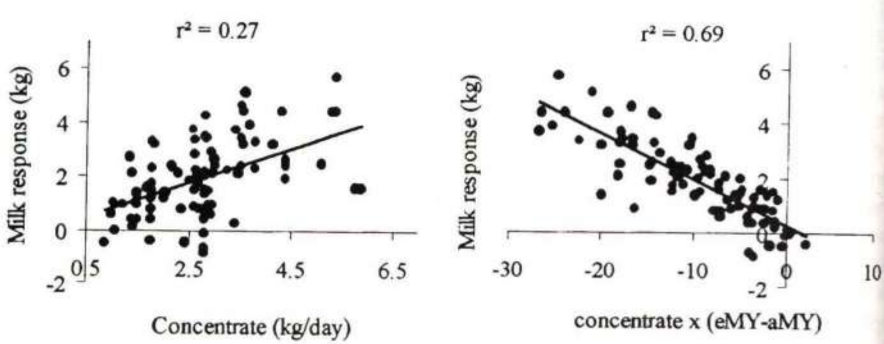
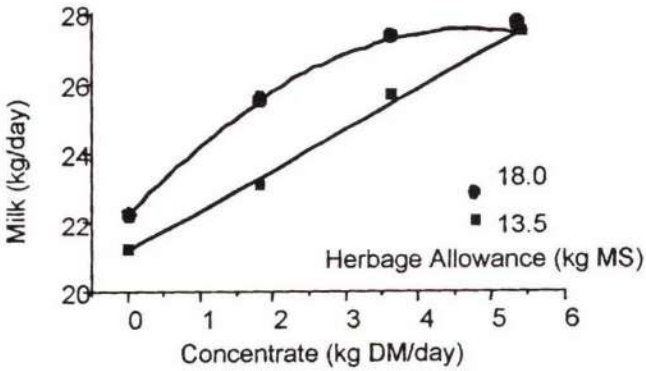


Figure 9. Influence of grazing conditions on the milk response to supplementation



As a consequence, several papers have reported that milk response increases when herbage availability is restricted. This occurs when stocking rate is increased on rotational grazing (Hoden *et al.*, 1991) or when sward height is reduced in set stocking management (Wilkins *et al.*, 1995). The interactions between level of concentrate and DHA on milk response to concentrate are illustrated in Figure 10. When herbage is restricted, there was a linear response in milk up to 6 kg of concentrate whereas on high DHA the response reached a plateau after 4 kg of concentrate. The energy balance may also differ according to the quality of grass. This is why the substitution rate is positively related to herbage digestibility (Grainger and Mathews, 1989). This also explains why milk response can increase during the grazing season when grass quality and grass availability are lowered. Gleeson (1981) reported a milk response increasing from 0.2 in spring to 0.6 in summer and 0.9 in autumn when pasture provides less energy because the grass quality and availability (fouled area, moisture) are lowered. Similarly, several studies conducted at Moorepark (Stakelum, 1986a; b and c; Murphy and Fitzgerald, 1998) have shown that the best responses to concentrate supplementation are generally achieved in summer and autumn. Thus, it appears there is scope for substantial improvement in response to supplementary concentrate inputs at grazing provided that inputs should be defined according to the grazing conditions which determine the energy balance of the unsupplemented cows.

Figure 10. Interaction between level of concentrate and herbage allowance on milk response to supplementation (after Delaby *et al.*, 2001)



Feeding concentrate generally decreases the ruminal pH and the acetate:propionate ratio. However interactions between supplementation and grazing conditions is also evident for the ruminal digestion processes. Feeding 4 kg of cereal grains, has marginally decreased the acetate:propionate ratio from 2.7 to 2.5 when herbage allowance was restricted, whereas the same supplement sharply decreased the acetate:propionate ratio from 2.6 to 1.8 on high herbage allowance because cows have access to a more leafy diet, which is more rapidly fermented (Delagarde and Peyraud, unpublished). The milk fat content followed similar trends with a larger decrease in high than in low allowance.

Nature of the supplement

Herbage intake is more drastically lowered when cows were supplemented with forages than with concentrates (Mayne and Wright, 1988). Under good grazing conditions, giving conserved forages (grass silage, hay or maize silage) as a buffer feed, results in high substitution rates, often over 1.0 (Leaver, 1985; Phillips and Leaver, 1985; Phillips, 1988). In these situations, very low milk responses or even a decrease in milk yield compared to control cows is obtained (Bryant and Donnelly, 1974; Leaver, 1985) because net energy content is lower in conserved grass than in fresh grass. No responses in milk yield were reported in France when spring swards were supplemented with good quality maize silage (Chenais *et al.*, 2001). The substitution rate between fresh grass and buffer forages decreases to 0.3 when the availability of fresh forage is restricted. Therefore forages supplements must only be provided during periods of grass shortage. The response to supplementary forages is then much higher in summer than in spring (Phillips and Leaver, 1985).

Energy source in the concentrate has little effect on milk production and substitution rate when moderate levels of concentrate are fed. Compared to 3.5 kg of wheat, which is a readily fermentable starch, feeding 3.5 kg of a concentrate rich in soya-bean hulls, which is a slowly degraded cellulose, increased milk fat content (+ 1.3 g kg^{-1}, Table 3), marginally decreased protein content (- 0.5 g kg^{-1}) and did not affect milk yield (Delaby and Peyraud, 1994). These differences between starch and fibre are even lower when using a concentrate rich in beet pulp and citrus pulps which are rich in rapidly fermentable pectins (Delaby and Peyraud, 1994; Meijs, 1986). The type of carbohydrate does not affect the substitution rate in indoors trials (Spörndly, 1991; Schwartz *et al.*, 1995). Under good grazing conditions some data suggest a marginally (0.5 to 1.0 kg DM day^{-1}) higher DHI with fibre compared to rapidly degradable starch (Kibon and Holmes, 1987; Fisher *et al.*, 1996; Sayers *et al.*, 2000). However when grass availability is restricted there is no substitution whatever the origin of the carbohydrate (Kibon and Holmes, 1987; Delagarde *et al.*, 1999). These results suggest that when moderate amounts of concentrate are delivered, the nature of energy does not necessarily produce enough digestive perturbations to affect animal performances. However because the effect of supplementation on ruminal digestion is much higher when cows have access to a high content of free leaf blades, concentrate supplements only moderately rich in rapidly degradable starch are preferred since the effects of highly fermentable starch increases when high doses were used. Sayers *et al.*, (2000) compared high starch and high fibre concentrate either at 5 or at 10 kg DM day^{-1}. They reported a dramatic fall in milk fat content with increasing amounts of starch (29.9 *vs* 36.6 g kg^{-1}) but not with increasing amounts of fibre (36.2 *vs* 39.4 g kg^{-1}).

Generally there should be little need to supplement dairy cows with protein sources at grazing. However, when the crude protein content of grass becomes low supplementation with metabolisable protein may be beneficial. Delaby *et al.*, (1996) described the response curve of milk yield when increasing the supply of MP. On well fertilised swards, with crude protein content greater than 16 % DM, milk yield marginally increases with protein supply whereas on low N fertilised swards, with a crude protein content lower than 13 % DM, the response may reach 2 kg milk for a supply of a extra amount of 500 g of metablisable protein. The lower the protein content of grass the higher is the response. In these situations, feeding concentrate with low degradable protein may alleviate a shortage of metabolisable protein supply to the cow, as duodenal flow of protein is sharply increased. As herbage intake is increased, total energy inputs also increase (Table 4).

Table 4. Influence of energy and protein sources on DHI by dairy cows grazing on swards with a low crude protein content (11%) (after Delagarde *et al*., 1999)

	No concentrate	Energy (Starch)	Protected Soybean meal
Concentrate intake (kg DM day^{-1}	0	2.8	2.8
Grass intake (kg DM day^{-1}	14.6	14.9	17.2
GRASS DIGESTIBILITY	0.774	0.761	0.793
Rumen VFA (mmoles l^{-1})	99	101	111
Protein flowing into the duodenum (kg day^{-1})	2.2	2.5	3.5
Milk yield (kg day^{-1})	19.6	22.0	24.8

Conclusion

Grazed grass is the cheapest source of nutrients for dairy cows and should form the basis of profitable animal production systems, and present a positive image of animal production to the consumers in Europe. Management of high producing animals at pasture is therefore a major challenge. The objective, is to achieve high levels of herbage intake per animal with full exploitation of the potential of grazed grass. Critical factors affecting intake include supplement feeding, sward characteristics and the cow itself. Recent results show that high producing cows can still achieve satisfactory levels of performances with high economic returns and only a moderate supply of concentrate, although they do not fully exploit their genetic potential. Given recent developments in our understanding of sward factors influencing grass intake and digestion, there is considerable scope to improve animal performances with grazed grass diets.

References

Arriaga Jordan, C.M. and Holmes, W. (1986) The effect of concentrate supplementation on high yielding dairy cows under two system of grazing. *Journal of Agricultural Science Cambridge* **107** 453-461.

Butler, S.B., Stakelum, G.K., Murphy, J.J., Delaby, L., Rath, M. and O'Mara, F.P. (*Submitted*) The relationship between milk production potential and herbage intake of grazing dairy cows.

Brumby, P.J. (1959) The grazing behaviour of dairy cattle in relation to milk production, live weight, and pasture intake. *New Zealand Journal of Agricultural Research* **2** 797-807.

Bryant, A.M. and Donnelly, P.E. (1974) Yield and composition of milk from cows fed pasture herbage supplemented with maize and pasture silages. *New Zealand Journal of Agricultural Research* **27** 491-493.

Butris, G.Y. and Phillips, C.J.C. (1987) The effect of herbage surface water and the provision of supplementary forage on the intake and feeding behaviour of cattle. *Grass and Forage Science* **42** 259-264.

Caird, L. and Holmes, W. (1986) The prediction of voluntary intake of grazing dairy cows. *Journal of Agricultural Science* **107** 43-54.

Chenais, F., Seuret, J.M., Brunschwig, P. and Fiorelli J.L. (2001) Pour un rôle croissant du pâturage dans les systèmes bovins laitiers. In 'Nouveaux regards sur le pâturage'. *Actes des journées de l'AFPF*, Paris, 20-21 mars 2001.

Christie, H., Mayne, C.S., Laidlaw, A.S., Patterson, D.M. and Mcgilloway D.A. (2000) Effect of sward manipulation and milk yield potential on herbage intake of grazing dairy cows. In:- Rook A.J., Penning P.D. (Eds), *Grazing management. BGS* Occasional Publication No. 34, 79-84.

Combellas, J. and Hodgson, J. (1979) Herbage intake and milk production by grazing dairy cows. 1. The effects of variations in herbage mass and daily herbage allowance is a short-term trial. *Grass and Forage Science* **34** 209-214.

Combellas, J., Baker, R.D. and Hodgson, J. (1979) Concentrate supplementation and the herbage intake and milk production of heifers grazing *Cenchrus ciliaris*. *Grass and Forage Science* **34** 303-310.

Curran, M.K. and Holmes, W. (1970) Prediction of the voluntary intake of food by dairy cows. 2. Lactating grazing cows. *Animal Production* **12** 213-224.

Delaby, L. and Peyraud, J.L. (1994) Influence de la nature du concentré énergétique sur les performances des vaches laitières au pâturage. *Rencontres Recherches Ruminants*, Décembre 1994, Paris.113-116.

Delaby, L., Peyraud, J.L., Vérité, R. and Marquis, B. (1996) Effects of protein content in the concentrate and level of nitrogen fertilisation on the performance of dairy cows in pasture. *Annales de Zootechnie* **45** 327-341.

Delaby, L. and Peyraud, J.L. (1997) Influence of concentrate supplementation strategy on grazing dairy cows' performance. XVIII International Grassland Congress, Saskatoon, Canada, 1111-1112. (texte intégral) ID No. 1427

Delaby, L. and Peyraud, J.L., (1998) Effet d'une réduction simultanée de la fertilisation azotée et du chargement sur les performances des vaches laitières et la valorisation du pâturage. *Annales de Zootechnie* **47** 17-39.

Delaby, L., Peyraud, J.L., Bouttier, A. and Pecatte, J.R. (1999b) Effect of grazing conditions and supplementation on herbage intake by dairy cows. *Rencontres Recherches Ruminants* **6** 139.

Delaby, L., Peyraud, J.L. and Delagarde, R. (1999a) Production des vaches laitières au pâturage sans concentré. *Rencontres autour des Recherches sur les Ruminants* **6** 123-126. Paris, France (Abstract in english).

Delaby, L., Peyraud, J.L. and Delagarde, R. (2001) Effect of the level of concentrate supplementation, herbage allowance and milk yield at turnout on the performances of dairy cows in mid-lactation at grazing. *Animal Production* ***73*** *171-181.*

Delagarde, R. (1997) Facteur de variation des durées d'ingestion et de rumination des vaches laitières en pâturage rationné. *Rencontres Recherches Ruminants* **4** 90.

Delagarde, R. and Peyraud, J.L. (2001) Caractéristiques de la prairie avant et après un pâturage: quels indicators de l'ingestion chez la vache laitière. *Rencontres autour des Recherches sur les Ruminants* 8, (*in press*). Paris, France (Abstract in english).

Delagarde, R., Peyraud, J.L.and Delaby, L. (1997) The effect of nitrogen fertilization level and protein supplementation on herbage intake, feeding behaviour and digestion in grazing dairy cows. *Animal Feed Science and Technology* **66** 165-180.

Delagarde, R., Peyraud, J.L. and Delaby, L. (1999) Influence of carbohydrate or protein supplementation on intake, behaviour and digestion in dairy cows strip grazing low nitrogen fertilised perennial ryegrass. *Annales de Zootechnie* **48** 81-96.

Delagarde, R., Peyraud, J.L., Delaby, L. (2000) Herbage intake of strip-grazing dairy cows: effects of herbage allowance, concentrate supplementation level and initial milk yield. *Proc. 18th Gen. Meet. Eur. Grassl. Fed., Aalborg*, 309-311.

Delagarde, R., Prache, S., D'Hour, P. and Petit, M. (2001) Ingestion de l'herbe par les ruminants au pâturage. In:- Nouveaux regards sur le pâturage . *Actes des journées de l'AFPF* Paris, mars 20-21, 2001.

Demarquilly, C. (1963) Influence de la nature du pâturage sur la production laitière et la composition du lait. *Annales de Zootechnie* **12** 69-104.

Demarquilly, C. and Jarrige, R. (1971) The digestibility and intake of forages from artificial and natural grassland. *Proc. 4th Gen. meeting of the European Grassland. Federation* Lausanne, France. 91-106.

Dillon, P., Crosse, S. and O'Brien, B. (1997) Effect of concentrate supplementation of grazing dairy cows in early lactation on milk production and milk processing quality. *Irish Journal of Agricultural and Food Research* **36** 145-159.

Ferrer-Cazcarra, R. (1995) Quantités ingérées et comportement d'ingestion des bovins au pâturage: influence du développement pondéral des animaux et de la hauteur de l'herbe. *Thèse de Doctorat de l'ENSA Rennes*, Série B, No. 62.

Fisher, G.E.J., Dowdeswell, A.M. and Perrott, G. (1996) The effects of sward characteristics and supplement type on the herbage intake and milk production of summer-calving cows. *Grass and Forage Science* **51** 121-130.

Fisher, G.E.J., Roberts, D.J. and Dowdeswell, A.M. (1995) The manipulation of grass swards for summer-calving dairy cows. *Grass and Forage Science* **50** 424-438.

Fuerst-Waltl, B., Appleby, M.C., Sölkner, J. and Oldham, J.D. (1997) Grazing behaviour of dairy cattle in relation to genetic selection for milk production. *Die Bodenkultur* **48** (3) 199-209.

Gibb, M.J., Huckle, C.A., Nuthall, R. and Rook A.J. (1999) The effect of physiological state (lactating or dry) and sward surface height on grazing behaviour and intake by dairy cows. *Appied. Animal Behaviour Science* **63** 269-287.

Gleeson, P.A. (1981) Concentrate supplementation for spring calving cows. *Grass and Forage Science* **36** 138-9.

Grainger, C. and Mathews, G.L. (1989) Positive relation between substitution rate and pasture allowance for cows receiving concentrates. *Australian Journal of Experimental Agriculture* **29** 355-360.

Greenhalgh, J.F.D. and Reid, G.W. (1969) The herbage consumption and milk production of cows grazing ST24 ryegrass and ST37 cocksfoot. *Journal of the British Grassland Society* **24** 98-103.

Greenhalgh, J.F.D., Reid, G.W., Aitken, J.N. and Florence, E. (1966) The effects of grazing intensity on herbage consumption and animal production. I. Short term effects in strip-grazed dairy cows. *Journal of Agricultural Science* **67** 13-23.

Hageman, I.W., Lantiga, E.A. and Schlepers, H. (1990) Herbage intake, digestibility characteristics and milk production of some diploid and tetraploid perennial ryegrass cultivars. Proceedings Second British Grassland Society Research Conference, Scottish Agricultural College, Ayr, September 11-13, 1990, paper 5, session 1.

Hijink, W.F., Le Du, Y.L.P., Meijs, J.A.C. and Meijer, A.B. (1983) Supplementation of the grazing dairy cow. Report IVVO No 141, Lelystad.

Hodgson, J. (1986) Grazing behavior and herbage intake. In: J. Frame (eds), *Grazing* Br. Grass Soc, Occasional Symposium **No.19** 51-63.

Hodgson, J. and Jamieson, W.S. (1981) Variations in herbage mass and digestibility, and the grazing baheviour and herbage intake of adult cattle and weaned calves. *Grass and Forage Science* **36** 39-48.

Hodgson, J., Rodriguez-Capriles, J.M. and Fenlon, J.S. (1977) The influence of sward characteristics on the herbage intake of grazing calves. *Journal of Agricultural Science Cambridge* **89** 743-750.

Holmes, W. (1980) Grazing management. In:- W. Holmes (eds), *Grass: its production and utilization*. BGS Occasional Symposium, Blakwell, Owford, 125-173.

Hoogendoorn, C.J., Holmes, C.W. and Chu, A.C.P. (1992) Some effects of herbage composition as influenced by previous grazing management, on milk production by cows grazing on ryegrass/white clover pastures. 2. Milk production in late spring/summer: effect of grazing intensity during the preceding spring period. *Grass and Forage Science* **47** 316-325.

Institut National de la Recherche Agronomique, (1989) R. Jarrige (ed), 'Ruminant nutrition: Recommanded allowances and feed tables'. INRA John Libbey, Londres, Paris.

Journet, M. and Demarquilly, C. (1979) Grazing. In: W.H. Broster and H. Swan (eds), *Feeding strategy for high yielding cow.* Granada Publishing, 295-321.

Kibon, A. and Holmes, W. (1987) The effect of height of pasture and concentrate composition on dairy cows grazed on continuously stocked pastures. *Journal Agricultural Science Cambridge* **109** 293-301.

Kolver, E.S. and Muller, L.D. (1997) Performance and nutrient intake of high producing Holstein cows consuming pasture or a total mixed ration. *Journal of Dairy Science* **81** 1403-1411.

Leaver, J.D. (1985) Milk production from grazed temperate grassland. *Journal of Dairy Research* **52** 313-344.

Le Du, J. (1980) Le pâturage continu: l'expérience anglaise. *Fourrages* **82** 31-43.

Mambrini, M. and Peyraud, J.L. (1994) Mean retention time in the digestive tract and digestion of fresh ryegrass by lactating dairy cows: influence of the grass maturity and comparison with a maize silage diet. *Reproduction Nutrition Développement* **34** 9-23.

Mayne, C.S. and Wright, I.A. (1988) Herbage intake and utilization by grazing dairy cows. In:- P.C. Garnsworthy (ed): Recent advances in Animal Nutrition 1988, pp 280-293. Butterworths, London, UK

Mc Gilloway, D.A. and Mayne, C.S. (1996) The importance of grass availability for the high genetic merit cow. In:-P.C. Garnsworthy, J. Wiseman and W. Haresign (eds): *Recent Advances in Animal Nutrition 1996.* Nottingham University Pres, Nottingham, UK.

Meijs, J.A.C. (1981) Herbage intake by grazing dairy cows. *Agricultural Research Reports* **909** Center Agricultural Publishing and Documentation, Wageningen, Netherlands. pp 264.

Meijs, J.A.C. (1986) Concentrate supplementation of grazing dairy cows. 2. Effect of concentrate composition on herbage intake and milk production. *Grass and Forage Science* **41** 229-35.

Meijs, J.A.C. and Hoekstra, J.A. (1984) Concentrate supplementation of grazing dairy cows. 1. Effect of concentrate intake and herbage allowance on herbage intake. *Grass and Forage Science* **39** 59-66.

Mosquera-Losada, R. and Gonzales-Rodriguez, A. (1998) Effect of annual stocking rates in grass and maize + rye systems on production by dairy cows. *Grass and Forage Science* **53** 95-108.

Mott, G.P. (1960) Grazing pressure and the measurement of pasture production. *Proceedings VIII International Grassland Congress* Reading, England. 606-611.

Murdock, F.R., Hodgson, A.S. and Austenson, H.M. (1960) A comparison of orchard grass, ladino clover and orchard grass as pasture for milking dairy cows. *Journal of Dairy Science* **43** 1675-1683.

Murphy, J., Fitzgerald, S. (1998) Concentrate supplementation of grass and silage. In S. Fitzgerald, Cahir, Co Tipperary (eds): 'The production of high quality milk from grass and other feeds', April 23, 1998.

O'Brien, B., Crosse, S. and Dillon, P. (1996) Effects of offering a concentrate or silage supplement to grazing dairy cows in late lactation on animal performances and on milk processability. *Irish Journal of Agricultural and Food Research* **35** 113-125.

O'Connell, J.M., Buckley, F., Rath, M. and Dillon, P. (2000) The effect of cow genetic merit and feeding treatment on milk production, herbage intake and grazing behaviour of dairy cows. *Ir. J. Agric. Res.* **39** 369-381.

Opatpatanakit, Y., Kekkaway, R.C. and Lean, L.J. (1993) Substitution effects of feeding rolled barley grain to grazing dairy cows. *Animal Feed Science and Technology* **42** 25-38.

Parga, J., Peyraud, J.L. and Delagarde, R. (2000) Effect of sward structure and herbage allowance on herbage intake by grazing dairy cows. In:- A.J. Rook and P.D. Penning (eds), 'Grazing management: The principles and practice of grazing for profit and environmental gain in temperate grassland system', *BGS Occasional Symposium* No. **34** 61-66.

Peyraud, J.L. (1993) Comparaison de la digestion du trèfle blanc et des graminées prairiales chez la vache laitière. *Fourrages* **135** 465-473.

Peyraud, J.L. and Astigarraga, L. (1998) Review of the effect of nitrogen fertilisation on the chemical composition, intake, digestion and nutritive value of fresh herbage: consequences on animal nutrition and N balance. *Animal Feed Science and Technology* **72** 235-259.

Peyraud, J.L., Astigarraga, L. and Faverdin, P. (1996a) Digestion of fresh perennial ryegrass fertilized at two levels of nitrogen by lactating dairy cows. *Animal Feed Science and Technology* **64** 155-171.

Peyraud, J.L., Comeron, E.A., Wade, M. and Lemaire G. (1996) The effect of daily herbage allowance, herbage mass and animal factors upon herbage intake by grazing dairy cows. *Annales de Zootechnie* **45** 201-217.

Phillips, C.J.C. (1988) The use of conserved forage as a supplement for grazing dairy cows. *Grass and Forages Science* **43** 215-230.

Phillips, C.J.C. and Leaver J.D. (1985) Supplementary feeding of forage to grazing dairy cows. 2. Offering grass silage in early and late season. *Grass and Forage Science* **40** 193-199.

Robaina, A.C., Grainger, C., Moate, P., Taylor, J. and Stewart, J. (1998) Responses to grain feeding by grazing dairy cows. *Australian Journal of Experimental Agriculture* **38** 541-549.

Rook, A.J. and Huckle, C.A. (1996) Sources of variation in the grazing behaviour of dairy cows. *Journal of Agricultural Science Cambridge* **126** 227-233.

Sayers, H.J., Mayne, C.S., and Bartram, C.G. (2000) The effect of level and type of supplement and change in the chemical composition of herbage as the season progresses on herbage intake and animal performance of high yielding dairy cows. In:- Rook, A.J. and Penning, P.D. (eds), 'Grazing management The principles and practice of grazing for profit and environmental gain in temperate grassland system', *BGS Occasional Symposium* No. **34** 85-90.

Schwartz, F.J., Haffner, J., Kirchgessner, M. (1995) Supplementation of zero-grazed dairy cows with molassed beet pulp, maize or a cereal-rich concentrate. *Animal feed Science and Technology* **54** 237-248.

Spörndly, E. (1991) Supplementation of dairy cows offered freshly cut herbage *ad libitum* with concentrates based on unmolassed sugar beet pulp and wheat bran. *Swedish Journal of Agricultural Research* **21** 131-139.

Stakelum, G. (1986a) Herbage intake of grazing dairy cows. 3. Effect of autumn supplementation with concentrates and herbage allowance on herbage intake. *Irish Journal Agricultural Research* **25** 31-40.

Stakelum, G. (1986b) Herbage intake of grazing dairy cows. 2. Effects of herbage allowance, herbage mass and concentrates feeding on the intake of cows grazing primary spring grass. *Irish Journal Agricultural Research* **25** 41-51.

Stakelum, G. (1986c) Herbage intake of grazing dairy cows. 3. Effects of herbage mass, herbage allowance and concentrate feeding on the herbage intake of dairy cows grazing on mid-summer pasture. *Irish Journal Agricultural Research* **25** 179-189.

Stakelum, G. and Connely, J. (1987) Effect of body size and milk yield on intake of fresh herbage by lactating dairy cows indoors. *Ir. J. Agric. Research* **26** 9-22.

Stakelum, G. and Dillon, P. (1990) Influence of sward structure and digestibility on intake and performance of lactating and growing cattle. In:- S. Mayne (ed), 'Management Issues for the Grassland Farmer in the 1990's'. BGS Occasional symposium No. 25.

Stakelum, G. and O'Donovan, M. (1998) Grazing severity, sward digestibility and intake and farm cover targets for profitable summer milk production. In:- S. Fitzgerald (ed), 'The production of high quality milk from grass and other feeds'. Cahir, Co Tipperary, April 23, 1998, 1-16.

Stakelum, G. and O'Donovan, M. (2000) Grass utilisation and grazing management for dairying..In S. Fitzgerald (ed), 'Dairying 2000 – Opportunities for the new', National Dairy Conference, Cork, November 16, 2000. 17-43.

Stockdale, C.R. and Trigg, T.E. (1989) Effect of pasture feeding levels on the responses of lactating dairy cows to high energy supplements. *Australian Journal Experimental Agriculture* **29** 605-611.

Thomson, D.J., Beever, D.E., Haines, M.J., Cammell, S.B., Evans, R.T., Dhanoa, M.S. and Austin, A.R. (1985) Yield and composition of milk from Friesian cows grazing either perennial ryegrass or white clover in early lactation. *Journal of Dairy Research* **52** 17-31.

Vérité, R. and Journet, M. (1970) Influence de la teneur en eau et de la déshydratation de l'herbe sur sa valeur alimentaire pour les vaches laitières. *Annales de Zootechnie* **19** 255-268.

Wade, M.H. (1991) Factors affecting the availability of vegetative *Lolium perenne* to grazing dairy cows with special reference to sward characteristics, stocking rate and grazing method. *Thèse d'Université de Rennes* 1, n° ordre 615, 76p.

Wade, M.H., Peyraud, J.L., Lemaire, G. and Comeron, E.A. (1989) The dynamic of daily area and depth of grazing and herbage intake of cows in a five day paddock system. *XVI International Grassland Congress*, Nice, France. 1111-1112.

Wade, M.H., Peyraud, J.L., Comerón, E.A. and Lemaire, G. (1995) The dynamics of daily milk production and sward height under paddock grazing conditions. *Ann. Zootech* **44** Suppl. 127.

Wilkins, R.J., Gibb, M.J. and Huckle, C.A. (1995) Lactation performance of spring-calving dairy cows grazing mixed perennial ryegrass/white clover swards of differing composition and height. *Grass and Forage Science* **50** 199-208.

Wilkins, R.J., Gibb, M.J., Huckle, C.A. and Clements, A.J. (1994) Effect of supplementation on production by spring-calving dairy cows grazing swards of differing clover content. *Grass and Forage Science* **49** 465-75.

Wright, I.A. and Whyte, T.K. (1989) Effects of sward height on the performance of continuously stocked spring-calving cows and their calves. *Grass and Forage Science* **44** 259-266.

Zoby, J.L.F. and Holmes, W. (1983) The influence of size of animal and stocking rate on the herbage intake and grazing behaviour of cattle. *Journal of Agricultural Science* **100** 139-148.

Investigating the role and economic impact of concentrate supplementation at pasture

J. Kennedy[ab], P. Dillon[a], P. Faverdin[c], L. Delaby[c], F. Buckley[a] and M. Rath[b]

[a] Teagasc, Moorepark Research Centre, Fermoy, Co Cork, Ireland, [b] Department of Animal Science and Production, University College Dublin, Belfield, Dublin 4, Ireland, [c] INRA,UMR Production du lait, 35590, St Gilles, France

Introduction

Milk production in Ireland is characterised by relatively low milk production per cow and low costs of production. This is primarily due to seasonal calving, and a pasture based system of milk production (Dillon *et al*, 1995). Since the early 1950's, a large number of studies have quantified the response in milk production to supplementing grazing dairy cows with concentrate. The principal factors controlling the response have been identified as the quantity and quality of the herbage allowed, milk yield potential and stage of lactation of cow plus the quantity and nature of the supplement. Historical reviews by Leaver *et al* (1968) and Journet and Dermarquilly (1979) obtained average responses of 0.4 and 0.6 kg milk per kg of concentrate DM respectively. A more recent review by Stakelum *et al.*, (1988) indicated a mean response of 0.5 kg milk/kg additional concentrate. Based on these responses it was generally accepted that when grass supply was adequate, concentrate supplementation at pasture was not economically justified (ased on concentrate to milk price ratio). However, in data published since 1990 (Peyraud, 2001), responses to concentrate supplementation at pasture are higher. Overall responses close to or greater than 1.0 kg of milk per kg DM of concentrate have been reported when less than 4 to 5 kg DM of concentrate is provided with high yielding cows.

It can be argued that the higher responses are related to the genetic merit of the present day Holstein-Friesian cow. The rate of genetic improvement for milk production per cow in Ireland up to the-mid 1980's was low (approximately 0.5% per year) compared to North America where it was increasing at 1.5% per year (Funk, 1983). However, since 1985 the rate of genetic improvement in Ireland has increased markedly to about 1.3% per year in 1992 (Coffey, 1992). This high rate of genetic progress has been achieved mainly through the importation of North American and European AI Holstein Friesian genetics.

The average level of concentrate supplementation (kg/cow/lactation) in spring calving dairy herds in Ireland is 745 kg (Buckley *et al.*, 2000). The objective of the present study was to determine the response of Holstein-Friesian cows of medium and high genetic merit to half and twice the industry norm level of concentrate supplementation in an adequate grass supply situation. As a consequence, this study sought to answer the following questions:

- To determine responses of Holstein Friesian cows to increasing levels of concentrate supplementation in an adequate grass supply situation over three years.

- To examine if milk yield responses to supplementary concentrate are influenced by genetic merit (milk yield).
- To determine the economic implications of different levels of concentrate supplementation at farm level under different critical cost/price variables and milk quota scenarios.

Experimental Details

Location of study

The study was undertaken from January 1998 to December 2000 at Moorepark Research Centre (Curtins Farm). The soil type was free-draining, acid brown earth on a sandy loam to loam texture.

Climate

All three years were normal in terms of summer rainfall and spring temperature.

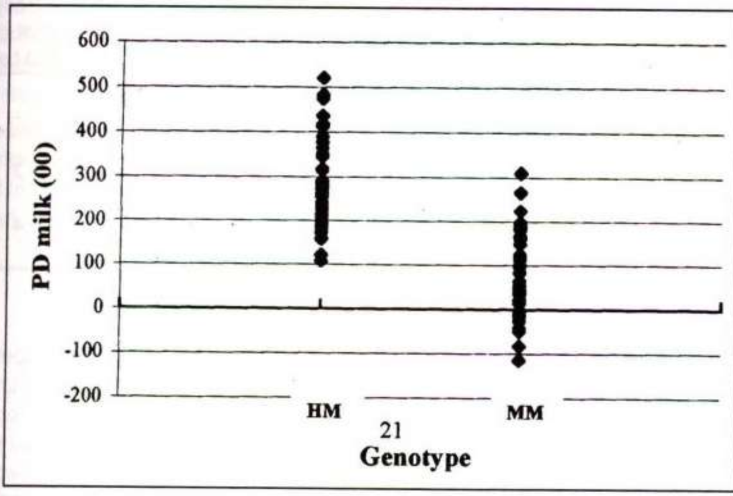
Experimental design

The study compared 2 levels of genetic merit by 3 levels of concentrate feeding on a spring calving system of milk production over three years (1998-2000). The mean predicted difference (PD00) and economic breeding index (EBI00) for the two genotypes are shown in Table 1. On average the EBI of the high merit cows (HM) was Î20.3 higher than the medium merit (MM) cows. However there was large variation in genetic merit within genotype with large overlap between genotype. Figure 1 shows the individual cow distribution in PD for milk yield for each genotype. The average proportion of Holstein-Friesian genes in the HM and MM cows was 65% and 75% respectively.

Table 1. The mean predicted differences (PD00) (± SD) within each genetic group and corresponding economic breeding index (EBI) for all cows on the study.

Genotype	Milk (kg)	Fat (kg)	Protein (kg)	Fat (g/kg)	Protein (g/kg)	EBI00 (€)
HM (±SD)	276 (100.1)	8.9 (4.75)	9.7 (3.19)	-0.030 (0.0858)	0.010 (0.0354)	41.9 (15.8)
MM (±SD)	81 (94.9)	3.8 (4.95)	4.3 (2.59)	0.013 (0.0989)	0.031 (0.0360)	21.6 (13.2)

Figure 1. The predicted difference (PD00) for milk yield for the individual cows in the high merit (HM) and medium merit (MM) genetic groups.



The average level of concentrate supplementation over the three years was 376, 810 and 1540 kg/cow/lactation for the low concentrate (LC) medium concentrate (MC) and high concentrate (HC) feeding systems, respectively (Table 2).

Table 2. Concentrate inputs (kg/cow/lactation) for the three years of the study

	Feeding system (kg)		
Year	LC	MC	HC
1998	436	806	1422
1999	348	781	1558
2000	345	844	1641

The concentrate supplementation strategy over the grazing season is shown in Table 3. The concentrate was fed individually twice daily in the milking parlour, except during the indoor period in early spring when cows were fed three times daily in the HC system. The composition of the concentrate was 25% barley, 25% corn gluten feed, 25% beet pulp, 10% soya bean meal, 10% rapeseed meal, 1% fat and 4% minerals and vitamins.

Table 3. Concentrate feeding strategy (kg/cow/day)

Feeding System	Calving to turn out	Early March to late April	1st May to late June	1st July to early-Oct.	Early October to end Lact.
LC	5	3 – 4	-	-	-
MC	7.5	4 – 5	3	-	2
HC	10	6 – 7	6	4	4

Grazing management

A permanent grassland site was used consisting of a sward with almost 100% perennial ryegrass (*Lolium Perenne*). The grazing season extended from late February until late November each year. On turnout to pasture, animals were grazed on a rotational management system (Dillon *et al.*, 1995). Each concentrate feeding system had its own farmlet comprising of 18 paddocks. Similar pre-grazing yields were maintained each week in each farmlet. This was facilitated by weekly monitoring of farm grass cover (O'Donovan, 2000). Similar post-grazing heights were also maintained in each system. Table 4 shows the average pre- and post- grazing heights, pre-grazing yields and daily herbage allowance (kg DM/cow) for each of the feeding systems averaged over the three years.

Table 4. Pre- and post-grazing height (cm), pre-grazing herbage yield (kg DM/ha) and daily herbage allowance (kg DM/cow) averaged over the three years of the study.

Measurement	Feeding Treatment		
	LC	MC	HC
Pre-grazing height	22.2	22.6	22.6
Post-grazing height	7.0	7.0	7.0
Pre-grazing yield	2136	2152	2115
Daily herbage allowance	26.1	24.0	23.0

Animal management

Post-calving in 1998 all cows were offered similar level of concentrate supplementation until late-April. In late-April 48 HM and 48 MM cows balanced for calving date and milk yield were randomly assigned to the three concentrate feeding treatments. Once cows were assigned to a feeding system, they remained on it for the three years. In 1999 and 2000, 18 and 12 first lactation cows entered the herd as replacements of similar genetic merit to that of the cows culled.

Milk yield was recorded on five consecutive days per week. The concentration of fat, protein and lactose was determined in one successive morning and evening sample per week. First lactation animals were given a 10-week dry period, while in subsequent lactations 8 weeks was considered sufficient. During the dry period animals were offered grass silage *ad-libitum*. Cows at the end of first lactation were offered 2 kg of concentrate daily for the first 5 weeks of the dry period.

The breeding season was confined to 13 weeks, starting in late April. Each year artificial insemination only was used for the whole of the breeding season. Tail paint was used as an aid to heat detection. Pregnancy diagnosis was performed by ultrasonography 30 to 40 days after service and by rectal palpation 6 weeks after the end of the breeding season.

Results

Milk production (a) Herd comparison

Table 5 shows the average milk production for the three years of the experiment. There was no significant interaction between genetic merit and feeding system for any of the milk production parameters measured. However both genotypes and feeding systems had a significant effect on milk yield and milk composition parameters. The exception was feeding system which had no effect on lactose content. On average over the three years the HM cows produced 1066 kg higher milk production, 1.7 g/kg lower fat content and 0.82 g/kg lower protein content compared to the MM cows.

Table 5. The effect of genotype and concentrate feeding level on milk production 1998-2000.

Genotype	HM			MM			Sig.		
Feeding level	LC	MC	HC	LC	MC	HC	SE	Geno	Feed
Yield (kg/cow)									
Milk	7228	7501	8268	6253	6527	7019	106	***	***
SCM	6534	6804	7505	5792	6228	6516	92.2	***	***
Fat	268	280	307	240	263	266	4.4	***	***
Protein	241	253	281	212	226	244	3.5	***	***
Lactose	335	346	383	292	306	331	4.8	***	***
Composition (g/kg)									
Fat	37.2	37.4	37.3	38.6	40.5	38.0	0.49	***	***
Protein	33.4	33.7	34.1	34.0	34.8	34.9	0.24	***	**
Lactose	46.4	46.1	46.3	46.7	46.9	47.3	0.16	***	NS

Table 6 shows the differences in PD's for milk, fat and protein yield and actual milk production with level of feeding. The differences in actual milk production between the genotypes were much larger in the HC systems than in the other two systems.

Table 6. Differences in predicted difference and actual production within level of feeding system

Milk Component	Difference in PD (kg/cow)	Differences in actual production (kg/cow/lactation) LC	MC	HC
Milk	195	975	974	1249
Fat	5.1	28	17	41
Protein	5.4	29	27	52

The response to feeding concentrate is shown in Table 7, and is calculated as the extra kg milk (or fat plus protein) produced from the extra concentrate fed in the MC and HC systems relative to the LC. There appears to be a higher response for the HM cows especially at the higher concentrate feeding level (HC).

Table 7. Mean responses to feeding concentrate (per kg concentrate as fed) of the MC and HC feeding systems relative to LC feeding system over the three years.

Genotype	HM		MM	
Feeding system	MC	HC	MC	HC
Components (kg/kg conc. as fed)				
Milk	0.64	0.90	0.64	0.66
Fat & Protein	0.056	0.068	0.087	0.050

Milk production (b) Individual cow data

As can be seen from Figure 1, there is a large overlap in genetic merit between the two genetic groups, hence it was decided to investigate further relationships between experimental milk yield using both pre-experimental milk yield (milk production as first lactation animals in April 1998) and pedigree index with concentrate supplementation level. There was a significant interaction between feeding system and both pre-experimental milk yield and pedigree index (Figure 2) for milk yield over the three years of the study. The difference between the concentrate feeding systems increases as both pre-experimental milk yield increase and pedigree index for milk production increases. Similar results are obtained for protein production with pre-experimental protein yield and pedigree index for protein production (Figure 3).

Table 8 shows that the response to increasing concentrate supplementation from 0.495 to 1.700 t /cow/lactation was 0.35, 1.06, and 1.33 kg milk/kg of concentrate fed for primiparous cows with pre-experimental milk yields of <24, 24-28, and >28 kg milk/day respectively. Similarly the response is 0.41, 0.76 and 1.33 for PD milk of <100, 100 to 200 and 200 to 300 kg of milk respectively (Table 9). Both tables indicate that at the low level of concentrate supplementation genetic potential is being restricted with high yielding/high genetic merit Holstein-Friesian dairy cows.

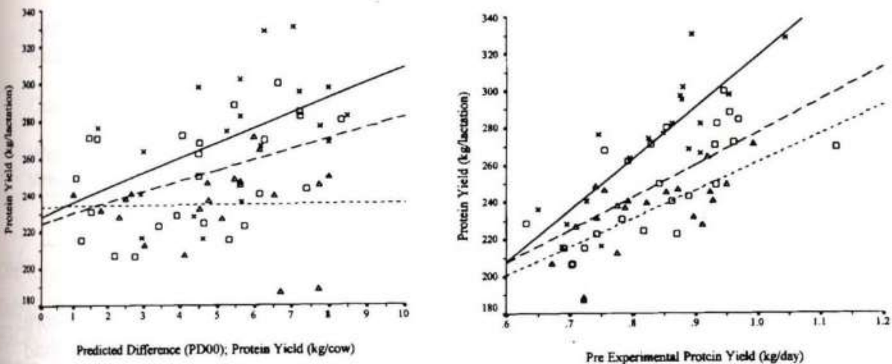
Table 8. Mean predicted lactation production over the three years (kg/cow) at pre-experimental primiparous milk yields of <24, 24 to 28 and >28 kg/day for low, medium and high concentrate inputs.

Pre-experimental milk yield	Concentrate inputs (kg/cow/lactation)		
(kg/cow/day)	495	950	1700
<24	6279	6428	6698
24-28	6783	7365	8072
>28	7337	7991	8942

Table 9. Mean predicted lactation production (kg/cow) at a PD of <100, 100-200 and 200 - 300 with low, medium and high concentrate inputs.

Predicted Difference (PD)	Concentrate fed (kg/cow/lactation)		
(kg)	495	950	1700
<100	6648	6759	7146
100-200	6971	7341	7892
200-300	7158	7842	8767

Figure 3. The relationship between predicted difference (PD00) for protein yield and pre-experimental protein yield on cow performance. (---, LC; ---; MC; ——; HC).



Liveweight

Tables 10 and 11 show the effect of genotype and feeding system on live-weight and live-weight change for 1999 and 2000, respectively. In both years both genotypes had similar live-weight post-calving, week 8 of lactation and at the end of lactation. Also in early lactation both genotypes had similar liveweight loss, while from week 8 to the end of lactation there was a tendency for higher liveweight gain with the MM cows. In both years feeding systems had a significant effect on liveweight at all three stages of lactation, the highest with the HC and lowest with the LC feeding system. However feeding system had no significant effect on liveweight change.

Table 10. Effect of genotype and feeding system on liveweight and liveweight change, 1999.

	Genotype			Feeding System				Sig.	
	HM	MM	s.e.	LC	MC	HC	s.e.	Geno	Feeding
Weight (kg)									
Post-calving	590	581	5.2	568	582	607	6.4	NS	***
Week 8 of lactation	526	521	4.8	509	521	541	6.0	NS	**
End of lactation	624	631	7.1	610	624	648	8.5	NS	**
Weight change (kg/cow/day)									
Week 1-8	**-1.31**	**-1.23**	0.05	**-1.20**	**-1.25**	**-1.36**	0.062	NS	NS
Week 8-42	0.40	0.46	0.02	0.41	0.43	0.44	0.026	**	NS

Table 11. Effect of genotype and feeding system on liveweight and liveweight change, 2000.

	Genotype			Feeding system				Sig.	
	HM	MM	s.e.	LC	MC	HC	s.e.	Geno	Feeding
Weight (kg)									
Post-calving	633	633	6.3	610	631	659	7.7	NS	***
Week 8 of lactation	556	658	5.2	539	554	577	6.4	NS	***
End of lactation	627	637	7.4	61.0	626	660	8.8	NS	***
Weight change (kg/cow/day)									
Week 1 - 8	**-1.58**	-1.54	0.05	**-1.44**	**-1.58**	**-1.66**	0.063	NS	*
Week 8 - 42	0.31	0.35	0.02	0.31	0.31	0.37	0.023	NS	NS

Condition score

Tables 12 and 13 show the effect of genotype and feeding system on condition score and condition score change for 1999 and 2000, respectively. The HM cows had significantly lower condition score at all three stages of lactation in both years. In both years the HM cows had significantly greater condition score loss in early lactation. Also from week 8 to the end of lactation the condition score gain was greater with the MM cows. Feeding system had a significant effect on condition score at all three stages of lactation in both years. The highest condition was obtained with the HC system, and the lowest with the LC system. Feeding system had very little effect on condition score change.

Table 12. Effect of genotype and feeding system on condition score and condition score change 1999.

	Genotype			Feeding system				Sig	
	HM	MM	SE	LC	MC	HC	SE	Geno	Feeding
Post Calving	3.27	3.40	0.03	3.32	3.29	3.39	0.031	**	*
Week 8	2.86	3.10	0.04	2.90	2.93	3.10	0.048	***	**
End of lactation	2.97	3.24	0.06	3.00	3.10	3.20	0.066	***	*
Condition score change									
Week 1-8	**-0.41**	**-0.30**	0.04	**-0.42**	**-0.35**	**-0.28**	0.043	*	*
Week 8-42	0.10	0.08	0.05	0.10	0.10	0.07	0.064	NS	NS

Table 13. Effect of genotype and feeding system on condition score and condition score change 2000.

	Genotype			Feeding system				Sig	
	HM	MM	SE	LC	MC	HC	SE	Geno	Feeding
Post Calving	3.27	3.40	0.03	3.32	3.29	3.39	0.031	**	*
Week 8	2.86	3.10	0.04	2.90	2.93	3.10	0.048	***	**
End of lactation	2.97	3.24	0.06	3.00	3.10	3.20	0.066	***	*
Condition score change									
Week 1-8	**-0.41**	**-0.30**	0.04	**-0.42**	**-0.35**	**-0.28**	0.043	*	*
Week 8-42	0.10	0.08	0.05	0.10	0.10	0.07	0.064	NS	NS

DM intake estimates

Table 14 shows the effect of both genetic merit and feeding system on grass DM intake (GDMI) and total DM intake (TDMI) in mid May and late August for each of the three years. On average over the three years the HM cows had 1 kg higher GDMI (16.1 vs 15.1). Over the three years of the study the average GDMI for all cows was 13.8,15.2 and 17.8 kg for 1998,1999 and 2000 respectively. Feeding system had a significant effect on both GDMI and TDMI. The highest GDMI was achieved with the LC feeding system and highest TDMI with the HC feeding system. Substitution rates (kg reduction in GDMI/kg increase in concentrate DM intake) range from 0.88 to 0.22. The higher substitution rates were obtained in 1998 and the lowest in 2000.

Table 14. Effect of genotype and feeding systems on grass (GDMI) and total (TDMI) intake.

			Genotype		Feeding system		
Year	Measurement	Intake	HM	MM	LC	MC	HC
1998	1	GDMI	13.1	11.5	14.3	12.8	9.9
1998	1	TDMI	15.8	14.2	14.3	15.5	15.3
1998	2	GDMI	15.8	14.8	16.1	16.3	13.4
1998	2	TDMI	17.0	16.0	16.1	16.3	17.0
1999	1	GDMI	14.5	13.6	15.7	13.9	12.5
1999	1	TDMI	17.3	16.4	16.1	16.6	17.9
1999	2	GDMI	16.9	15.7	17.0	16.7	15.3
1999	2	TDMI	18.1	16.8	17.0	16.7	18.8
2000	1	GDMI	17.5	16.6	18.4	17.0	15.8
2000	1	TDMI	20.4	19.4	18.8	19.7	21.2
2000	2	GDMI	19.0	18.1	18.9	18.8	18.1
2000	2	TDMI	20.2	19.3	18.9	18.8	21.7

Reproductive performance

The reproductive performance averaged over the three years is shown in Table 15. No significant effect of genotype or feeding system on any of the fertility parameters measured was observed. However there were large differences in reproductive performances between years, with the poorest being achieved in 2000. The reproductive performance of the MM cows tended to be better on average for all fertility parameters measured than the HM cows. Feeding systems had very little effect on reproductive performance other than the pregnancy rate to 2nd service tended to be higher for the HC feeding.

Table 15. Effect of genetic merit and feeding system on reproductive performance.

	Genotype		Feeding system		
	HM	MM	LC	MC	HC
Days to 1st observed oestrous (days)	39	37	38	41	36
Cows served in 1st 3 week (%)	88	90	92	89	85
Calving to conception interval (days)	92	89	91	93	89
Services per cow	1.83	1.68	1.77	1.77	1.72
Pregnancy rate:					
1st service (%)	49	57	51	54	54
2nd service (%)	54	42	42	35	66
Pregnant (%)	83	88	85	88	84

Table 16 shows the proportion of cows treated for abnormal ovarian function/non-cyclicity and the number of treatments per cow over the three years. On average 32% and 22% of the HM and MM cows were treated for abnormal ovarian function over the three years. Also the number of treatments per cow were greater for the HM cows. Feeding system had very little effect on treatment for abnormal ovarian function. The overall pregnancy rate for the cows treated for abnormal ovarian function was 67% compared to 93% for the non - treated cows.

Table 16. Cows treated for abnormal ovarian function/non cyclicity (inactive, cystic etc) over the three years

	Genotype		Feeding system		
	HM	MM	LC	MC	MC
Cow treated (%)	32	22	28	25	28
Treatment/cow	0.42	0.28	0.38	0.33	0.33

Economic analysis

The milk production performance achieved in the LC and HC feeding systems was used for economic analysis. The Moorepark Farm Economic Model (Veerkamp *et al*, 2001) was used to compare the economic performance of the different systems. The following assumptions were used in the model farm:

Quota size	227,000 litres
Farm size	16.2 hectares
Enterprise	Dairying
Concentrate cost	£150/tonne
Milk price	22p/litres
Quota leasing charges	7.7p/litres
Opportunity cost of land	£371/hectare

Using the production performance achieved in the LC feeding system as the control, the farm profit achieved was £28,129 (excluding labour and living expenses costs). Using the assumption in the farm model increasing concentrate feeding to the level of the HC feeding system increased farm profit to £29,080 (+£951). However if it was not possible to lease milk to maintain cow numbers then farm profit was reduced to £27,242 (-£887).

The difference in farm profit as effected by key critical variables such as concentrate cost (£100, £125, £150, £175 and £200/t), milk price (18p, 20p, 22p, 24p and 26p/litre), quota leasing charges (4.4p, 5.5p, 6.6p, 7.7p, 8.8p/litre) and opportunity cost of land (£247, £309, £371, £432, and £494/ha) on the economics of feeding the HC feeding system is shown in Figure 4. In all scenarios (execpt where concentrate costs was less than £100/t) where quota leasing was not available i.e. cow numbers are reduced, there was a reduction in farm profit with the HC system. Where quota leasing was possible (i.e. cow numbers maintained) the critical variables were concentrate and leasing quota costs, plus milk price. Opportunity cost of land had only a small effect on farm profit. In situations of low concentrate costs (< £125/t), high milk price (>24p/l), and low quota leasing charges (<6.6p/l) opting for the HC system will result in an increase of £1,600 to £2,600 in farm profit. However at high concentrate costs (>£150/t), low milk price (<22p/l), and high quota leasing charges (>6.6p/l) there was no financial benefit to the HC system.

Table 17 shows the effect of varying response rates (kg milk/kg concentrate fed) to feeding the higher concentrate level (HC). The same assumptions were used as that in the farm model. The results indicate that the response would have to be greater than 0.80 kg of milk per kg of concentrate to be economic in a quota-leasing scenario. As shown earlier this will very much depend in the genetic merit (milk yield potential) of the herd.

Table 17. Effect of varying concentrate response on farm profit

	Concentrate response (kg milk / kg of concentrate fed)			
	0.4	0.6	0.8	1.0
Milk yield (kg/cow)	7207	7439	7672	7905
Farm profit (£)	-681	+185	+1055	+1926

Summary

The average milk production of 7,228 kg/cow with the HM cows on the LC feeding system indicates the relatively high milk production potential of high merit cows in an Irish grass based feeding system. This is much higher than that achieved in other countries in grass based systems. Kolver (2001) obtained a milk production of 4,678 kg/cow with high merit North American Holstein-Friesian genetics in a low stocked New Zealand grazing system. Fulkerson (2000) obtained a milk production of 4,953 kg/cow with high merit North American Holstein-Friesian cows in an Australian production system. In the present study the LC feeding system restricted the ability of the HM cows to express fully there genetic potential. In the LC system production potential is reduced by cow size and condition score at calving, other than level of feeding post-calving. The average milk yield of 9105 kg/cow with the HM cows in the HC feeding system in 2000 would indicate milk production was close to genetic potential using US milk yield as a comparison.

The HM cows produced 1066 kg higher milk yield, 29 kg higher fat yield and 31 kg higher protein yield than the MM cows. The difference between genotypes was much larger on the HC feeding system than either of the other two systems. The average response to concentrate supplementation was 0.71 kg milk/kg of concentrate fed for the MC and HC feeding systems relative to the LC feeding systems over the three years. However analysis of individual cow data indicated an interaction between genetic merit and concentrate feeding level for both milk and protein yield. This indicated a higher milk yield response to concentrate supplementation with the higher genetic merit cows. Using pre-experimental milk yields of <24, 24 to 28 and >28 kg/day as first lactation animals the response to increasing supplement from 0.495 to 1.7 t/lactation was 0.41, 0.76 and 1.33 kg respectively/kg of concentrate fed.

Genotype had no significant effect on live weight, while the cows in the HC feeding system were of significantly higher live weight. Both genotype and feeding system had no significant effect on live weight change in early lactation (weeks 1 to 8). There was a trend towards better live weight gain with the MM cows in weeks 8 to the end of lactation. The condition score of the MM cows was significantly higher at all stages of lactation. Similarly the condition score of the MM cows in the HC feeding system were higher than in the LC feeding system.

The GDMI estimates of the high merit cows were on average 1kg higher than the MM cows. The highest GDMI was achieved with the LC feeding system, while the higher TDMI was with the HC system. Substitution rates range from 0.88 to 0.22kg reduction GDMI/kg increase in concentrate DM allocation. The higher substitution rates were obtained in 1998 and the lowest in 2000.

Genotype had no significant effect on reproductive performance, however the reproductive performance of the MM cows was better for all reproductive parameters measured. Concentrate feeding level had no significant effect on reproductive performance over the three years. There were big differences in reproductive performance between the three years with the poorest in 2000.

There was a reduction in farm profit in almost all scenarios with the HC feeding systems where cow numbers had to be reduced (no quota leasing scenario). In scenarios where quota leasing was achieved at <6.6 p litre and concentrate cost less than £115/tonne and/or milk price was around 24 p/litre there was an economic advantage of approx. £1600 to £2600 to the HC feeding system. However when milk price was less than 22 p/litre, concentrate cost greater then £150/t and quota leasing costs were greater than 6.6 p/litre, there was no economic advantage in the HC feeding system.

References

Buckley, F., Dillon, P., Mee, J.F., Evans, R. and Veerkamp, R. (2000) Trends in genetic merit for milk production and reproductive performance. *Proc. Dairying 2000 – Opportunities for the new millennium.*

Coffey, M., (1992) Genetic trends – has progress been made in the last six years? *Holstein-Friesian Journal* **74** 62-63.

Dillon, P., Crosse, S., Stakelum, G. and Flynn, F. (1995) The effect of calving date and stocking rate on the performance of spring - calving dairy cows. *Grass and Forage Science* **50** 286–299.

Fulkerson, W.J. (2001) The productivity of Friesian cows: effect of genetic merit and level of concentrate feeding. Final report – DAN 082.

Funk, D.A. (1993) Optimal genetic improvement for the high producing herd. *Journal of Dairy Science* **76** 3278–3286.

Journet, M. and Demarquilly, C. (1979) Grazing. In : Feeding strategy for the high yielding cow. Brooster, W.H. and H. Swan,(Eds.). Granada, London, pp. 295–3221.

Kolver, E., Napper, A. and Copeman, P. (1999) Lactation potential of Holstein Friesians. Occas. Publication. DRC. Hamilton, New Zealand.

Leaver, J.D., Campling, R.C. and Holmes, W. (1968) Use of supplementary feeds for grazing dairy cows. *Dairy Science Abstracts* **30** 355–361.

O'Donovan, M. (2000) The relationship between the performance of dairy cows and grassland management on intensive dairy farms in Ireland. PhD Thesis, University College, Dublin.

Peyraud, J.L. (2001) Complementary supplementation of grazing dairy cows. R&H Hall Technical Bulletin Issue No 2 2001

Stakelum, G., Dillon, P. and Murphy, J. (1988) Supplementary feeding of grazing dairy cows. Moorepark Dairy Farmers Conference, Teagasc, Dublin, pp 27 – 27.

Veerkamp, R.F., Dillon, P., Kelly, E., Cromie, A.R. and Groen, A. F. Dairy cattle breeding objectives combining yield, survival and calving interval for pasture – based systems in Ireland under different milk quota scenarios. Livestock Production Science (*in press*)

Byelaws and Farming Practices

PATRICK J. PHELAN
Teagasc, Dromin Road, Nenagh

Land usage

The agricultural area of Ireland is approximately 4.5 million ha of which 3.6 million ha is under grass, 0.5 million ha is under rough grazing and 0.4 million ha is under crops (DAFF, 2001). In 2000 there was 408,000 tonnes of Nitrogen (N) and 49,000 tonnes of Phosphorus (P) applied.

Land – a critical and essential resource

Land yields food and water. Both are essential to the survival of present and future generations. In order to ensure the survival of our children, of their children, of their children's children, we must manage our land resources so that quality food and water can be harvested into the future. The intensive food production needed to meet growing population and the income demands of farm families has resulted in high stocking rates and intensive farmyard usage.

High stocking rates

High stocking rates require high inputs to produce fodder. Nitrogen and P application to land have resulted in huge yield increases in grass and crop yields. However those same nutrients, particularly P also give huge increases in algal and plant growth if they end up in surface water. Excessive growth of algae and plants makes water unsuitable for drinking, for fish life and for leisure activities.

Intensive farmyards

High animal numbers either for wintering or daily movement for milking requires the collection of high volumes of animal dung, urine and dairy wash water. Animal wastes if used efficiently are a valuable source of nutrients but if allowed to escape present a serious hazard to water quality. Fifty cattle wintered in a yard, with no facilities to collect animal wastes, would produce approximately 700 kg N and 100 kg P. These quantities of nutrients and the biological oxygen demand would produce serious quality problems if added to water.

Targeting of resources to reduce loss of Phosphorus from Agricultural land to water

In order to improve water quality the sources of contamination must be identified and remedial measures put in place. Research indicates that 80 to 90 % of P losses from land to water occur from as little as 10 % of the land area draining to any given water catchment. The Environmental Protection Agency (EPA) (1999) has indicated that the best improvement in water quality will be achieved by targeting control programmes to those areas. Geographical Information System (GIS) based assessment is recommend by both the EPA and Department of Environment and Local Government (DOELG) as the best means of identifying hotspots and targeting resources.

The Need for By-laws

Surface Water

Water quality monitoring by the EPA (1999) has identified an increase in the extent of slight and moderate pollution in Ireland's rivers and streams. This is attributed mainly to "animal manures and artificial fertilisers, and to a lesser extent to point source discharges e.g. sewage. The recent slight increase in the extent of seriously polluted channels is attributed mainly to suspected sewage discharges and to a lesser degree to suspected agricultural activities". The report formed the basis for the requirements under the P Regulations (S.I. No. 258 of 1998, Local Government (Water Pollution) Act, 1977 (Water Quality Standards for P) Regulations, 1998). One of the indicators of achievement under those regulations is the introduction of new by-laws. DOELG (1997) has stressed the need to manage rivers and lakes and reduce enrichment of water with nutrients, particularly P by focusing on the main contributors – agriculture, sewage and industry.

Ground Water

Irish ground waters are generally of high quality. The main concern is the presence of faecal coliforms in some samples analysed by the EPA. Faecal contamination has been identified as a serious problem in samples from private water schemes. This contamination is most likely due to either sewage or animal manures. High nitrate levels (i.e. mean concentrations >50 mg/l) have been identified by the EPA in Carlow, Kildare, Limerick and Louth. Agricultural practices are suspected as contributing to the elevated levels.

Response

The introduction of by-laws is a response by Local Authorities (Cork County Council (1999), Cavan County Council (2000), Tipperary North Riding County Council (2000) and Westmeath County Council (2000) and a recommendation of the Lough Derg and Lough Ree Catchment Monitoring and Management System (2001) to the nutrient load to water from agriculture. Byelaws are also an option to be considered for the catchments of the Boyne, Liffey and Suir by the Three Rivers Project Water (2000) in the event of failure to put adequate voluntary measures in place. Inadequate storage of organic materials in farmyards, poor timing of application and excessive nutrient application are the issues to be resolved.

Lough Derg and Lough Ree Catchment Monitoring and Management System

The Lough Derg and Lough Ree Catchment Monitoring and Management System was the first major catchment-based water management project in Ireland. Its objectives were to identify and locate pollution problems within the Derg and Ree catchments and to recommend control strategies. The principal findings relevant to agriculture were from four Special Study sub-catchments, three Agricultural mini-catchments and from the development of GIS.

Special Study sub-catchments

Table 1. The % Phosphorus loading from the principal contributors was determined in four sub-catchments.

	Brosna	Nenagh	Camlin	Hind
Agriculture	52	57	54	21.5
Urban and Industry	32	35	35	74.5
Background	8	8	8	7
Worked peat	8		3	

Agricultural mini-catchments

Catchment Description

Table 2. The three agricultural mini-catchments were selected to represent the different farming systems and conditions within the Derg and Ree catchments.

	Clarianna	Bellsgrove	Grange Rahara
County	Tipp NR	Cavan	Roscommon
Size Km^2	28	12.5	12
Predominant Soil Type	Grey Brown Podzolic	Gley	Grey Brown Podzolic
Enterprises	Dairying, tillage, cattle	Cattle and sheep	Sheep and cattle
Av. Farm Size	35	21	34
Soils Index 4 (%)	46	22	10
Storage Deficit (%)	40 – 25	20	<10

Catchment Water Quality

Water quality was determined by analysis of grab samples taken twice each week.

Table 3. Water quality during the period April 1999 – March 2000.

	Clarianna	Bellsgrove	Grange Rahara
Median MRP (ug P/l)	16	32	5
Median Oxidised Nitrogen (mg N/l)	5	2.5	.6
Disolved Oxygen (% saturation)	88 – 139	50 - 98	

The median MRP was satisfactory in all three years of monitoring in the Clarianna. However the median oxidised nitrogen levels are a cause for concern. The dissolved oxygen levels also indicate poor water quality. The median MRP in the Bellsgrove exceeded the minimum median target of 30 ug P/l specified in the P Regulations. The maximum MRP level recorded was 296 ug P/l. Median oxidised nitrogen and dissolved oxygen levels were also unsatisfactory. The Grange Rahara had satisfactory nutrient levels during the sampling period.

Geographical Information System
A GIS was used to investigate the relationship between agricultural factors and water quality. A P ranking scheme was produced by giving a weighting to each factor and a score determined by intensity. This enabled the production of a map of Potential Agricultural Risk Areas within the Derg and Ree catchment.

Table 4. Phosphorus Ranking Scheme

Factor	**Factor Weighting**	**Risk Class**	**Score**
Chemical fertiliser Loading	12	(0-9 kg/ha)	0.8
		(10-11 kg/ha)	1.6
		(12-14 kg/ha)	2.4
		(15-19 kg/ha)	3.2
		(20+ kg/ha)	4.0
Organic Fertiliser Loading (cattle, Sheep, poultry)	24	(0.0-1.0LU/ha)	1.0
		(1.0-1.5LU/ha)	1.5
		(1.5-2.0LU/ha)	2.0
		(2.0 + LU/ha)	4.0
Organic Fertiliser Loading (piggeries)	24	(low potential)	0.8
		(mod.low potential)	1.6
		(mod.high potential)	3.6
		(high potential)	4.0
Soil Phosphorus Levels	16	(0-5 mg/l)	1.0
		(6-9 mg/l)	2.0
		(10-14 mg/l)	3.0
		(15+ mg/l)	4.0
Runoff risk to Surface Waters	24	(very low risk)	1.0
		(low risk)	1.5
		(medium risk)	2.5
		(high risk)	4.0

Table 5. Comparison between identified agricultural risk areas and surface water quality (April 1998 – March 1999)

Risk Category	**Number of Sampling Stations**	**Number Satisfactory**	**Number Unsatisfactory**	**Average MRPConcentration (mg P/l)**
Very high	13	7	6	0.054
High	45	27	18	0.035
Medium	125	110	15	0.019
Low	7	6	1	0.015

Phosphorus Ranking of Agricultural Mini-catchments

Table 6. Application of the Phosphorus Ranking Scheme to Agricultural Mini-catchments

	Clarianna	Bellsgrove	Grange Rahara
Chemical fertilizer.	38	29	29
Organic fertilizer	48	46	48
Organic fertilizer (IAE)	62	96	19
Soil Phosphorus	45	32	32
Runoff Risk.	36	48	36
Total Score	229	251	164

This resulted in most townlands in the Clarianna being classed as high risk, the Bellsgrove as very high risk and the Grange Rahara as being medium risk. Byelaws were consequentially recommended for the Clarianna and the Bellsgrove.

County Implementation of Byelaws

To date bye-laws have been introduced in three catchments in Cork to address identified water quality problems, and in town lands identified by the P ranking scheme in the counties Cavan, Tipperary NR., and Westmeath. Recommendations for byelaws have also been made in specified areas in Counties Leitrim, Longford and Offaly. Requirements in the bye-laws areas are for Nutrient management plans for significant pig and poultry enterprises, for storage and management of waste on all farms, and P fertiliser applications to be based on NMP on all farms in town lands with high soil P levels. Record keeping by the farmer is a requirement in all cases.

Table 7. County implementation of byelaws

Ongoing	Short Term (mid 2002)	Med. Term (mid 2004)	Long Term (mid 2007)	Time scale not stated
Cork	Longford	Galway	Kildare	Kilkenny
Cavan	Offaly	Kerry		Leitrim
Tipp. NR	Mayo	Waterford		Limerick
Westmeath	Carlow			Sligo
	Tipp. SR			Dublin South

Measures to be adopted by Irish Farmers

Bye-Law Areas

Implement the measures specified by the Local Authority and adopt the codes of Good Agricultural Practice.

Table 8. Measures required by Local Authorities under Agricultural Bye-Laws

	Target nutrients	Waste storage requirement (wks)	Nutrient application limits.	Nutrient Management Plans required	Timing of nutrient applications
Tipp NR	P	16 (within 3 yrs)	Planner specified to meet crop req. and water protection	Townlands with P Index 4 and farms with IAE imports	Specified by planner subject to approval of L.A.
Cavan	P	24 (within 3 yrs)	Planner specified to meet crop req. and water protection	Farms with IAE imports	Specified by planner subject to approval of L.A.
Westmeath	P	20 (within 3 yrs)	Planner specified to meet crop req. and water protection	Townlands with P Index 4 and farms with IAE imports	Specified by planner subject to approval of L.A.
Cork	N and P	13 (immediatly)	Max. 250 kg/ha organic N but where groundwater NO_3 >20 mg/l –210 kg/ha chemical N and P to Teagasc recommendations	Specified catchment areas	No chemical N 1/Oct. – 1/Jan. Slurry only in growing season.

Other Areas

Voluntary, preventative actions are preferable to byelaws. All farmers should adopt th Code of Good Agricultural Practices. This should result in improved water quality ar reduce the risk of byelaw areas being extended.

Implications of Byelaw requirements for farmers

Plans will have to be paid for, implemented and reported on. Nutrient manageme plans should result in more precision, better use of nutrients and improved co efficiency on many farms. Restrictions on stocking rates and N applications will reduc output on more intensive farms. Improvements or additional storage facilities a expensive and will not generally yield an economic return. Failure to comply is offence and liable to penalties under Section 21 (3)(b) of the Local Government (Wat Pollution)(Amendment) Act, 1990.

Farmer attitudes to water quality

Farmers are concerned about water quality *per se*, but their major concerns relate to th financial implications for themselves and the threat of increased paperwork. They als fear that achieving improvements in water quality will result in restrictions to far management practices and decreased incomes. They are aware that "everyone" will benefit from improved water quality. Many would like to see "everyone" pay for those improvements or at least be given an opportunity to pay for it. Suggestions made by farmers on financing such improvements included:

i) The State provides a grant scheme, not restricted to income units or production targets, for improved facilities to protect water quality on byelaw areas.
ii) Reduced interest rates should be made to provide facilities.
iii) Income tax incentives should be provided.
iv) The consumer could be given the option of paying a voluntary levy on farm produce to assist improvements or indeed to compensate farmers who have provided and manage facilities properly.
v) Compensation should be paid for loss of income.

Conclusion

Water quality is suffering due to agricultural activities. The strategy to minimise pollution at present is to identify the factors and areas doing the most damage and to concentrate resources in those areas. The introduction of byelaws by some local authorities is seen as a means of meeting obligations to improve water quality. EU directives and national regulations are here to stay, so are the EPA, DOELG, the Local Authorities and the requirement for good quality water. It is in the interest of farmers and the nation to ensure that Irish Agriculture does not fade away. The survival of farming and it's potential to progress will be strongly influenced by the will and ability of farmers to respond to the challenge of maintaining quality clean water and improving quality where damage has occurred.

References

Environmental Protection Agency (1999) Water Quality in Ireland 1995 – 1997.

Three Rivers Project - Water Quality Monitoring and Management (2000) Interim Report.

Lough Derg and Lough Ree Catchment Monitoring and Management System (2000) Final Report.

Department of the Environment and Department of Agriculture, Food and Forestry (1996) Code of good agricultural practice to protect waters from pollution by nitrates.

Department of Agriculture, Food and Forestry (2001) Fact Sheet on Irish Agriculture.

Cavan County Council (2000) Water Pollution (Agricultural) Byelaws, 2000

The County Council of the County of Cork (1999) (Regulation of agricultural practice in the catchments of the river Lee, the river Gradogue and the river Funshion) Bye Laws 1999.

Westmeath County Council (2000) Water Pollution (Agricultural) Bye-Laws 2000.

Tipperary (North Riding) County Council (2000)

Local Government (Water Pollution) (Amendment) Act (1990) Bye-Laws for the purpose of preventing or eliminating the entry of polluted matter to water.

Department of Environment and Local Government (1997) Managing Ireland's Rivers and Lakes: - A catchment-based Strategy against eutrophication.

Farming Profitably, efficiently, and with due care for the Environment

Richard Hinchion
Crookstown, Co. Cork

Background

Helen and I milk a spring calving herd of 55 cows supplying Dairygold Coop. We rear all our replacements and some beef on 39 ha of grassland of which 13 ha are rented. The farm is situated near Crookstown Village in mid-Cork, just off the N22 – the main Cork-Macroom – Killarney route over looking the Bride Valley. The farm ranges from 300 - 600 ft. above sea level with a relatively steep fall on one third of the farm. The farm has a southerly aspect, which enhances spring turnout. However, in very dry weather like June 2001 we suffered from drought. The soil consists of a loamy soil type to a depth of 6 - 9 inches over old red sandstone giving a relatively free draining soil.

Herd Performance 2000

Milk yield:-	6765 l/cow (1490 gallons/cow)
Concentrates:-	765 kg/cow
Butterfat:-	3.82%
Protein:-	3.39%
Stocking rate:-	0.44 ha/LU (1.1 acre/LU)

Grassland Management

Good paddock system and roadway.
All farm reseeded in past 15 years.
Two sward system – same ground cut all the time.
Turnout date - 3rd March by day; 10th March full-time.
All silage ground grazed and closed by 5th April.
Silage cutting date 29th May – 22nd July.
Housing:- yearlings = early Nov.
other cattle = mid Nov.
milking cows = early Dec.

Fertilizer

We spread our 1st application of Nitrogen in the form of Urea on 11th January and plan to cease in mid-Sept. Last year we used: -

	N	P	K
kg/ha	349	7.5	30
Units/acre	283	6	24

Farming and the Environment

Farmers throughout the country are nowadays subject to various County Council byelaws, codes of practice and inland fisheries inspections. By now you will all have received and read the Good Farming Practice booklet sent out by Minister Walsh recently.

What is Good Farming Practice?

'Good Farming Practice is common sense farming which cares for the environment and meets minimum hygienic and animal welfare standards' – quote from the booklet. As a farmer I see no conflict between good farming practices and care for the environment. A large number of farmers are complying with this code already including the 45,000 farmers who are in Rural Environment Protection Scheme (REPS), therefore we have nothing to fear. However, it is important for the authorities to allow ample time to digest this new code and common sense must prevail when the relevant authorities are carrying out inspections. Farmers have shown over the past 3 years that they are quick to follow Teagasc advice when the new Phosphates recommendations were issued – late 1997.

Using soil analysis and proper nutrient management planning we have seen a 20% decrease in national sales of both Phosphorus (P) & Potash (K). To such an extent that there is now cause for concern in Teagasc and the fertilizer industry concerning the big decrease in K levels. As a farmer, while we strived hard to get P levels under control we may have taken our eye off K levels. This is certainly the situation in my case, which you will see later on. So we need to take corrective action to rectify this imbalance.

Storage

The proper management and storage of slurry and other waste will involve good buildings and proper storage facilities. On our farm we have: -

A covered slatted tank with slurry storage for 12 weeks;
All rainwater is diverted away from slurry and effluent tanks;
All dairy washings and soiled water are stored with the silage effluent and is spread via a sprinkler system on nearby paddocks.
It is vital that all slurry tanks are empty by late summer.

Fertilizer/Slurry Programme

I will outline how my programme has evolved since 1997.

Prior to 1997 silage ground received;
2000 gallons slurry/acre + 2 bags/ac 0.7.30. in Winter/Spring
57 kg/ha (46 Units/ac) of urea Nitrogen in January
Graze silage ground in spring.
86 kg/ha (70 Units/ac) of urea Nitrogen for 1st cut in late March
1500 gallons slurry/acre + 3.5 bags/ac Cut Sward (24-2.5-10) in May/June
CAN (27.5%N) for aftergrass in July

A comprehensive soil analysis in 1997 produced the following results: -

Soil Analysis (ppm) profile.

		1997	
		P	K
Kelleher's	S2	19	158
Big Field	S1	35	201
Hayfield	S1	30	177
Fort field	S1	21	170
Average		26	177

The S signifies silage field for one or two cuts. You can see at a glance that our phosphorus levels were quite high.

For 1998 – 2000 we amended our fertilizer plan as follows:-

Eliminated 2-3 bags/ac of 0.7.30. and Urea for 1st cut silage. Also changed to Super Cut (Cut Sward and 3.5%Sulphur) for 2nd cut silage. Timing of slurry application was also improved.

We have become more conscious about the timing of spreading slurry and make better use of weather forecasts when planning to spread. Due to paddocks being closed in mid October for the following spring there are heavier grass cover on fields receiving slurry. Therefore there is more leaf in the sward to take up the fertilizer/slurry so avoiding leeching and run-off. By spreading in the springtime the plant can utilise the Nitrogen in the slurry more efficiently.

Following further sampling in December 2000 we noticed our P level had dropped but still remained good. However, our K level was much too low and action needed to be taken.

Soil Analysis (ppm) profile

		2000	
		P	K
Kelleher's	S2	10	50
U. Brake	S2	8	67
Jack/Sandy	S2	10	40
Big field	S1	15	75
HayField	S1	19	126
Average		12	71

2001 Fertilizer Programme
Same quantity of slurry applied but with better utilization.
46 Units/Ac of urea Nitrogen in spring.
Assume 1/3 carryover of N for silage area.
4 bags/ac (80N/Ac+60K/Ac) of LEIFI Boost (20-0-15) for 1st cut.
3 bags/ac (80N/Ac) of Super Net (27%N+3.5%S) for 2nd cut.
1.5-2 bags/ac (45N/Ac) of CAN for aftergrass.

From 1996 – 2000 we have reduced our fertilizer cost by 1p/gal. We have still grown the same amount of grass with no loss in performance. We had planned to reduce our fertilizer cost further this year but the price increase in 2001 will claw back our savings.

In December 2001 we will soil sample these fields again to see if we have turned the corner as regards K level or whether we will have to continue with further inputs of K to bring it to an acceptable level for best performance.

Summary

I hope I have given you a good insight into my simple farming practices. You can also see from my paper that it is possible with proper nutrient management to increase profit without any conflict of interest, while still caring for our environment. It is in all our best interests to practice sustainable farming rather than have further legislation imposed on the agricultural industry.

I would like to thank my Teagasc adviser Peter O'Leary for the past 25 years for his advice along with the many other advisers with whom I have been involved with down through the years.

Quotation

'Ask not what your country can do for you but what you can do for your country-side'.

Technology transfer for my Farm

WILLIAM KINGSTON

Tooreen, Caheragh, Skibbereen, Co. Cork

When you hear of technology transfer, I am sure you all think off e-mail, text messages, gigabytes and hard disks. However to me and on my dairy farm, technology has a much simpler meaning. Technology provides me with the tools that enable me to develop my business in the next 10-12 years. Once a business has a clear and precise vision of where it wants to be the rest is relatively easy. Today I am going to tell you where I stand and how I plan to drive my business forward into the future. Following on from this I will discuss the technical requirements needed to grow into the future.

I have heard it said that giving an army the best weapons and technology available doesn't guarantee victory unless the strategy is right. Presently a third year farm apprentice (John Dillon) and myself run the farm, which consists of 150 spring calving cows and replacements along with some dry cattle. The milking cows have access to 225 acres of grazing land. I live in a part of the country where grass does not stop growing and some people would say it never stops raining either. The system that I am trying to put in place can be described by two words, Profitability and Simplicity. *Profitability* is getting the most money out of a system that doesn't need continuous reinvestment, and comes from making the most out of the natural advantages of the farm and the ability of the people working it. *Simplicity* in the sense that the farm can be easily run, that the person running the farm is not literally "running everywhere", and that time can be dedicated to certain jobs at certain times of the year. It is also important that we enjoy what we do.

The technology required to get a clear focus into the future is strategic planning – looking ahead and working towards a goal. Subconsciously we all do some of this with our aspirations. Having done a course with strategic planning as one of the core topics, I have acquired a lot of knowledge on how to make a structured approach to planning. I am presently putting this into place. Having worked out what I want and where I am going it is obvious to me that four main areas have to be considered.

1. The right breed of cow

A vast amount of research has been done and is still being done on animal breeds & breeding. What I need is a cow that produces a reasonable amount of high solids milk, that requires low maintenance and can last at least 5-6 lactation's. In the past I have relied on the AI station to produce the best bulls and have selected from them on the basis of RBI and protein. Moorepark has trialled these high genetic merit animals to see what they are capable of doing, but alas now that we all have reasonable merit cows, we realise that we have the wrong ones - too high maintenance costs due mainly to infertility. What we need now is a planned approach to selectively breeding our way out of this problem. This approach is being tried in Moorepark. Numerous farmers have taken proactive cross breeding genetics from around the world, striving to get their ideal cow. I am now finding that the best technology transfer in this situation is to make direct contact with the farmers involved.

2. Business management

This mainly covers progress monitoring of the targets that have been set by planning. The area that requires most attention is budgets and cash flow projections. It is no longer good enough to meet the accountant two months after the end of the tax year and hear that meal feeding has gone up, this information is 12-15 months out of date. A computer is an aid that will help pull information together, but a word of warning – spending £1,500 on a modern computer and software package does not mean you become an excellent bookkeeper over night. We constantly bookmark our production costs against the top 5% and we need to do a lot more of this. Sourcing these figures may be difficult but with the help of our advisor, accountant and other farmers these figures are out there.

3. Grass & grassland management

A long grazing season with quality grass is the best key to profit and simplicity. Up to 5 years ago the method of grass seed selection for me was to go down to my local Co-op and look for Drinagh No.2 - not the most scientific approach I must admit. From going to farm walks I quickly realised that late heading varieties with early spring growth held the key. Moorepark has done some excellent research on grass seed selection, and from this and with the help of my Teagasc advisor, choosing grass seed has become a lot easier. New grass varieties are always coming through and we need to get these production traits onto our farms as soon as possible. On the grazing front there is alot more trial and error involved. I feel that the ideal grass covers for our farm are best found by referring to as much historical measurement as possible. This means by having at least the last two autumns grass cover figures in front of you when the years budget is being done. Measurement is the most important technology throughout the grazing year to make sure the cows are fully fed and that there is sufficient grass cover to carry over into the spring. On technology transfer, I do find the plate-meter more constant than eyeballing if you are sending different people out measuring during the grazing season.

4. Labour management

There are two areas to labour, one is labour efficiency, which Tom Dunne is covering tomorrow, and the other is labour management. One example of labour efficiency is calf rearing. Batch rearing calves, once per day feeding and early turnout to grass has really changed our approach to calf rearing. This technology has come from farm walks and talking to other farmers. Teagasc are doing a large scale project on labour. The information we need from this survey includes opportunities of saving time economically, also it should be complied in a way that if I was building a new milking parlour, I should see that a backing gate will save 10 minutes, a dump-line 30 minutes in the spring, and so on. From this information it sould become clear what is working well at farm level and what is good sales talk. Labour management is another large area. To motivate staff and keep them committed and content requires a skill that has to be learned. The use of a farm manual, which gives exact details of tasks and methods employed, is an excellent idea that I know must be brought onto my own farm. Things like communications, bonuses and time off that I am only getting to grips with. I find talking to farmers with staff as well as managers of small businesses gives me an insight into the technology that is required.

Summary

To summarise, there is a massive challenge in dairy farming today, but concentrating on key areas prevents me from getting bogged down in the smaller issues. A lot of technology is out there, and once you know what you want, the use of the phone or a trip to where the information can be gathered is the simplest and in my eyes the most efficient way of getting technology back onto my farm as quickly as possible.

The changing Role of Technology Transfer in New Zealand

PETER JENSEN

Chairman, Dexcel, New Zealand

Introduction

In 1998 the New Zealand industry undertook a significant long-term strategic planning exercise, which became the springboard for a series of changes in the delivery and effectiveness of on-farm research and development.

A new Dairy Industry Restructuring Bill is currently being considered by the New Zealand parliament, and is expected to be passed in October. The Bill will enable the two large dairy manufacturing companies, Kiwi and the New Zealand Dairy Group, to join with the New Zealand Dairy Board to become a single organisation by June of next year. The New Zealand Dairy Research Institute, which focuses on dairy product and process research and development, and ViaLactia Biosciences, which manages the industry's investment in biotechnology, will become subsidiary organisations of the new manufacturing and marketing company. The Bill also enables the Livestock Improvement Corporation to become a user-owned co-operative.

This paper reports on the subsequent changes in dairy farm production research and extension.

Funding of Industry Good Activities

There are many advances in knowledge and technology that will be of benefit to New Zealand farmers. However, the cost of their development would not allow individual farmers to undertake it on their own. Furthermore, it would be impossible to protect the results of the investment to prevent farmers who hadn't paid for the developments from using them on their farms. These are called industry good activities and much of the farm production research and extension are examples of such activities.

The current Dairy Board Act required the Dairy Board to fund industry good activities on behalf of dairy farmers. The funds were sourced directly from revenue from dairy product sales and this meant that dairy farmers were paying for research and extension although the process was not highly transparent. In addition, both government and private sources were providing funding in some areas.

The dairy industry is now working with the New Zealand government to establish a process whereby all milk that is produced for sale will be subject to a compulsory levy. Funds collected in this way will be used for industry good activities and the process will be highly visible to dairy farmers. In order to replace current levels of Dairy Board funding the levy would have to be of the order of 0.6% of a farm's income from the sale of milksolids or the equivalent of approximately three New Zealand cents per kilogram of milksolids.

Productivity of New Zealand Dairy Farming

For some years the New Zealand dairy industry has been concerned about the declining annual cash surplus position of the average dairy farm owner. The international competitiveness of New Zealand dairying has also been threatened by the performance of large USA dairying feedlots, especially with the rapid uptake of genetically modified crops, and by the potential of grassland dairying in South America. The 1998 Strategic Plan confirmed this position by comparing the productivity of New Zealand dairy farming with its counterparts in various parts of the world. In this context the productivity of a dairy farm is measured as:

The annual productivity ratio is, of course, heavily affected by three external factors, namely international prices of dairy products, exchange rates for the floating NZ dollar (especially relative to the US dollar which is the benchmark currency for traded dairy products), and seasonal weather conditions for grassland dairying. However, even with the external effects removed by using five-year rolling averages for the average owner-operator dairy farm, the following diagram still displays a decline in productivity.

A detailed econometric analysis of total factor productivity, at an industry level, is currently underway in order to isolate factors associated with the productivity decline, but I am confident that the three most important factors will be:

- the price that farmers have been paying and continue to pay for land;
- the cost-price squeeze on margins in internationally traded products;
- the increasing farm costs in fertilisers and supplementary feeds that farmers have been incurring to feed cows of higher genetic merit, relative to the milksolids responses to better feeding.
- The challenge for dairying in New Zealand is to arrest this decline.

Creating Dexcel

In June 2000 the New Zealand Dairy Board announced its decision to establish a Dairying Centre of Excellence to improve the competitiveness and profitability of New Zealand dairy farmers. A transition board and project team steered development of the Dairying Centre of Excellence until December 2000 when it was formally established in the form of a new organisation called Dexcel Ltd. Dexcel is operated as a commercial trust and became fully operational on February 1st, 2001.

The name 'Dexcel' is derived from the phrase 'dairying centre of excellence'. This new organisation is the industry's response to the pending deregulation of the Dairy Board, the change to a levy funding system, and to the declining performance of New Zealand dairy farming. Incorporating the former Dairying Research Corporation (DRC) and the Consulting Officer service of Livestock Improvement Corporation (LIC), Dexcel is accountable for leading the drive to improve the competitive position of New Zealand dairy farmers, and will play a pivotal role in achieving the dairy industry's 4% on-farm productivity improvement target. It will achieve this by combining and enhancing the considerable capabilities provided by DRC science and the Consulting Officer extension services to co-ordinate production research and development, undertake whole-farm systems research and ensure the knowledge gained from that research is taken up on farms.

Dexcel is also networking with other organisations servicing the dairy sector to optimise whole farm systems, and will work with the Crown to attract Government investment into key industry areas such as production research and vocational training. Dexcel provides a focused voice for farm productivity, and will enable the dairy industry to pull together and co-ordinate all of the activities related to on-farm research and development. Under the leadership of Dexcel, extension and farm research and development is now linked, extension is becoming more targeted, provision is being made for industry good research, and the former almost exclusive technology focus of research and extension is being broadened to include capability, delivery and change.

At present Dexcel employs 140 fulltime staff and approximately 30 casual workers. One hundred of the fulltime staff work in research related areas and 40 work in extension. For the dairy farming sector, Dexcel plans to achieve the following:

- Provide technology and knowledge to increase the productivity of farming systems and improve annual total productivity by 4%.
- Improve sustainability of dairying through the increased use of farming systems which do not compromise the environment and the welfare of dairy cattle.
- Improve human resource capability for the dairy industry through the promotion of dairy farming, the development of technological and professional capabilities and the provision of training opportunities for dairy farmers and their staff.
- The key activities that will enable Dexcel to achieve these outcomes include:
- Undertaking whole farm systems research and linking this capability to a strong internal extension group.
- Commissioning component research studies from external research providers by using its internal research capability to engage the external sector.
- Closely monitoring the impacts of research and extension on the productivity of farming.

Strategies for Increasing Productivity

The following diagram displays the results of a survey on the productivity profile of about 400 New Zealand dairy farmers for the 1999/2000 season. Roughly half were owner-operators and half were 50/50 sharemilkers. As depicted in the diagram, a larger proportion of those surveyed need the impact of customised extension strategy, rather than immediate technology advances, to achieve a productivity improvement. A significant component of Dexcel's extension strategy will be to use our small extension group to engage the much larger private sector of farm consultants, veterinarians, bankers and accountants in activating farmers to analyse their own farm businesses and the opportunities for future growth.

A second obvious, but not new, observation in relation to achieving sustainable productivity gains is the positive impact of having high quality people throughout the industry or sector. Accordingly, Dexcel will put a high priority on investing in education and training - from vocational training for employed farm staff through to attracting the highest quality undergraduates and postgraduates into studying dairying related disciplines.

In New Zealand one cannot maintain the right to practise as a chartered accountant without investing an annual effort in personal skill development and training. Likewise in dairying, issues relating to environmental impacts of dairying and the safety of dairy food products along with the need to effectively manage their farm will require farmers to continuously lift the skill-set in running their business.

Concluding Remarks

One of the outstanding successes in supporting farming in the previous century was the US land grant college system. In this system each US state had a designated university with responsibility and capabilities to undertake agricultural education, research and extension. In these modern times it will not be possible for the New Zealand dairy industry to own and replicate the land grant college system for dairying education, research and extension. However, with a small internal capability in farm systems research and extension, Dexcel intends to achieve the success of the land grant college system by managing relationships and networks to encompass the full range of services that our industry needs. We also believe that by managing networks, as opposed to owning all the bricks, mortar and capabilities we will be able to rapidly respond to advances in technology and an ever-changing set of demands from a global food market.

Technology transfer in Ireland, the present and the future

EDDIE MCQUINN
McQuinn Consulting, Farm Business Consultants, Tralee, Co. Kerry

Introduction

In my view, there is no area within the Irish agricultural industry more neglected than financial management at farm level. Over the past couple of years there has been a dramatic increase in the demand by more progressive farmers for information and guidance on the subject. The use of IT (information technology) represents an opportunity to address this issue and help to improve the efficiency and competitiveness of farm businesses. In the following I propose discussing a few of the most important financial management tasks in urgent need of attention on Irish farms and where current technology could usefully embraced.

The Past

From a financial management perspective, the features of Irish farming could be summarized as follows: -

- Relatively small unit size where making a 'living' was a priority;
- Adequate or surplus labour supply. Automation not a priority and lack of capital often a limiting factor to improvement;
- Adequate time available to 'think', prior to decision making;
- Minimal paper work involved in day to day running of farm;
- No suitable cost effective technology available with practical application;
- Managers lacked basic IT skills and failed to appreciate the potential contribution IT could make to their businesses.

Current Trends on Irish farms

While there are many internal and external forces influencing and indeed forcing change in Irish agriculture, at farm level the following trends are amongst the more obvious: -

- Work force on farms declining and wage costs increasing;
- Automation an economic necessity for survival;
- Farm managers operate within a fast moving environment with ready access to information in order to help make informed decisions quickly;
- Bad decisions are punished more severely and the consequences are more serious. (A 5% variation in a large unit is much more serious than a corresponding variation in a small unit);
- More paperwork is now required within the farm gate. Compliance with various schemes as well as the statutory requirements use scarce resources such as labour where farm offices are not computerized;
- Increased automation being used by those institutions interacting with farming on a regular basis;
- A more technically skilled workforce now exists on farms than here to fore. In addition, access to the necessary skills is relatively easy.

- Financial margins continue to get slimmer and strict financial control has now become vital for survival and prosperity;

Technology application in financial management on Irish Farms - one approach

Mission Priorities - apply technology that is: -

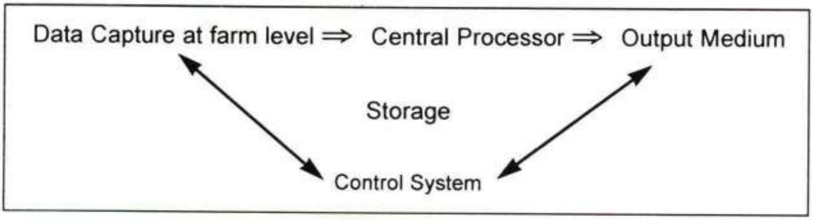
- The best available at the least cost;
- Capable of giving the manager enhanced control by converting data into information.
- Make information available to managers that is: -
  - Accurate;
  - Timely;
  - Complete;
  - Relevant;
  - Easily stored for future reference;
  - Easily updated when combined with additional information at a later date.
- Demand on skills should be within the capacity range of managers;
- The operation of the system should not impose excessive time demands.
- The system should be flexible to a wide user range.

Building blocks of technology on Irish farms

Financial and management accounts

There is now an opportunity to deploy technology in an area that is at the core of financial management on Irish farms.

Diagram outlining how this would operate is as follows:



Data is assembled at farm level, electronically transferred to a central processor, processed and the resultant information electronically returned to the original source.

The essential elements of such a system include: -

Data Capture. At farm level this may be through keyboard, scanner or network. It is likely that dairy co-ops, livestock marts etc will soon be able to network their customers/suppliers. This will enable sales data to be transferred electronically to producers from where it may be again transferred to the central processor without input from the farm manager. Input purchases (cheque payments) for the farm may also be entered into the computer directly at the time the purchase is being made, avoiding duplication at a later stage.

The *central processor* will organise, manipulate, sort and calculate data and transform it into information. This will usually be a dedicated server unit.

Data *storage* may be through discs, CD-ROM, tapes etc. These devices will allow data to be stored and retrieved at a later stage.

An *output medium* allows information to be communicated back to the farm manager. The most convenient methods to display output are through computer screens, printer, facsimile machines etc.

A *control system* operates the entire information technology system. Simple systems may use Windows, DOS etc. and off the shelf software.

Advantages of system: -

- Inexpensive.
- Provides manager with timely information including: -

  Year to date costs and returns (Profit) versus budgets;

  Allows managers compare the performance of their businesses with that of units in similar circumstances;

  Creditors / Debtors;

  Input usage against budget.

  Cash Flow against budget.

  Calculated Bank balances against actual.
- Allow managers to make informed decisions for their business.
- More time released to managers allowing them an opportunity to address the bigger issues affecting the business including cost control, strategic planning etc.
- Provides managers with greater control of the business, which is an added valuable resource.
- Allows accountant/advisor more time to interpret information and provide informed analysis of the business.

Electronic Discussion Group

On farm discussion groups, though used in the past by only a minority of farmers, have experienced a renaissance in the recent past. They have proved to be a valuable source of information, support and indeed a social outlet for many farmers. However, they have limitations and there are topics and aspects of the farm business that many farmers are reluctant to discuss openly. In addition the small size of groups limit the scope of new ideas, opinions etc.

An approach that uses modern technology in order to make relevant Information readily and cheaply available to farm managers is the use of the Intranet. This is similar to the Internet but operates within the confines of a single organization. This approach could be coordinated by a firm of agricultural consultants who would also provide a professional input. Individual users would be given a unique password, may log on anonymously and e-mail their query. Other managers may then offer their opinions as well as a professional opinion from the coordinators.

Advantages of such a system: -

- No limit on the number of users.
- Provides unlimited geographic spread for participants.
- May be used at managers discretion i.e. they use it at a time that is convenient to them.
- Inexpensive to use.
- Provides rapid access to information.
- Allows sensitive topics to be discussed in confidence.

Typical discussion topics might include bank charges, input costs, technical queries etc.

Conclusions:

- The financial management skills of farm managers need to be addressed.
- Information needs to be made available that is timely, relevant, complete and accurate. (Software is now available to address these issues).
- IT helps to improve business efficiency thus leading to increased profitability and all that goes with it.
- Managers must take more control of their businesses.
- Managers must make more time for 'thinking', for strategic planning, for family, lifestyle etc.
- Farming has become a solitary existence and managers need support and assurance as well opinions from peer groups.

Electronic Discussion Groups can now keep individual managers in touch with like-minded people as well as their professional advisers. Sensitive matters may be discussed in confidence. Geographic location is no longer a barrier.

My approach to efficient dairying as an avenue to expand, prosper and invest

DAVID HANNON
Derrypatrick, Drumree, Co Meath

Introduction

My approach to farming is to run the farm as a business. This approach is based on the underlying fact that milk price does not keep up with inflation yet inputs do, and so to prosper the farm needs to be run efficiently to get the most out of it (see Table 1).

Table 1. The pattern of milk price compared with inflation in last 15 years

Year	1986-1990	1991-1995	1996-2000
Milk Price p/gallon	92.8	100.1	102.2
Inflation	100	115.2	130.6

Source: CSO & Golden Vale milk prices at 3.3% protein & 3.6 % fat.

Family Farm Details

Married to Catherine and we have five children.

133 adjusted acres owned

43 adjusted acres rented

Soil type - heavy

137 cows

150,000 gallons of milk quota

50 replacement units

1 and a half labour units (including myself)

In 1995 we took over the farm. The 1st farm plan was based mainly at reducing debts. This was achieved by:-

Getting out of beef in 1996. As a result turnover dropped but not the profit. Profit is more important than turnover.

Selling the silage outfit. Expenditure on the farm during this period was mainly on infrastructure (roadways, provision of water, fencing, etc.).

In 2000 the 2nd farm plan widened to include 3 goals:-

Grow our net worth;
Be able to retire at 55 if we wish;
Have a comfortable lifestyle;

Running an efficient and simple farm system can achieve these goals. For the purpose of this paper, I will be focusing on the 1st goal, *growing our net worth*. This is achieved through the following:-

1. Simple System

The system is based on a compact spring-calving herd with grazed grass contributing the greater part of the diet. The aim is to have a system that can be run by one person at all times. Targets needed to achieve this are 100% of cows calved in 10 weeks and 95% submission rate in first 3 weeks of the breeding season. Cows go to grass about mid-February by day and full time in early March (2001 was the exception when it was nearly April due to lack of grass). The number of paddocks closed for silage is flexible and depends on grass growth and level of grass cover at these times.

Good handling facilities enables one-person to keep the place under control. In the collecting yard we have a backing gate with a scraper that allows cows to be directed into the parlour without the need to leave the pit (it also scrapes the yard!). For AI, hoof pairing etc. cows can be diverted using a diverting gate as the cows leave the parlor. The out farm is laid out with its own handling facilities, central roadway and fencing to allow easy movement of animals by one person. All of these save time and make the movement of animals safe and efficient.

2. Cost control/high product price

An important part of achieving this is being a member of both a discussion and purchasing group. The discussion group allows us to throw ideas around and compare our costs with top farmers. We can discuss topics of importance at specific times, e.g. AI and heat detection around April, grass management during the summer period, etc. We also organise speakers to talk to us on banking, shares, insurance etc. The information and timing of information can be invaluable.

The purchasing group helps to get good value for money. Target costs are at less than 40% of Gross Farm Income and all costs are looked at. We also believe in getting the top price you can for your product, which is equally as important so we aim for high quality milk with high protein levels.

3. Time Management

We try to work smart and not hard. With a little planning and organisation we have time for ourselves, the kids, planning, work and other investments. A lot of time can be wasted collecting meal, going to the hardware store. Often delivery charges are small or non existent, and by phoning around we can find where the best value is and get it delivered. We use FRS for peak times, days off and holidays.

<u>*Planning and Target Setting*</u>

Planning and target setting is probably the most important part of any business but cannot be achieved without devoting time. There are two types of planning; *short-term* - day-to-day target setting, which are achieved by (a) budgeting (e.g. daily feed targets like grass, meal etc. and fortnightly financial commitments), and (b) good record keeping. This involves meeting seasonal targets such as cow submission rates, SCC levels, monthly milk protein levels etc. The second type of planning is for the *long term* - this is back to the farm plan and where we want to be long after the five year plan is over (i.e. goals) but this will change as our needs and circumstances change. With good financial planning we know where we are and where we are going. This allows us to use our resources to their best potential and have enough money to live and pay the bills. **Expand, Prosper and Invest**

We make money, what do we do with it?

1. *Farming*

With quotas, expansion can be slow, but there are other resources on the farm.

Cottage: - This we intend to develop.

Shed: - These could be let.

Human Resources: - People are the back bone of anything. We have skills and talents that can be used.

2. *Non-Farming*

Short Term – After peak supply is reached, surplus money becomes available from milk sales. In many cases, this money is left untouched but not utilised efficiently. Surplus money e.g. money to pay bills and live through the quite times of the year often is not utilised. With good budgeting we can remove surplus money from the current account and put it on deposit and get over 4% interest; e.g. £10,000 for 6 months =£200. If this was £30,000 for 6 months = £600. This could provide for a few days away.

Long Term - pensions, shares and property

A pension has 2 advantages, it gives us security and freedom to retire and do what we want with our other assets. The other reason is it is allowable against tax and so is a good investment particularly since the rules on pensions have changed.

Table 2. Internal rate of return of different investments

Investment	Internal Rate of Return
Investment in a Dublin Property (1974®2000)	25%
Share in a Financial Institution (1974®2000)	16%
Investment in a Dairy Farm (post-labour) (1974®2000)	13%

Source: McCarthy (2000)

From Table 2 it is obvious that shares and property are better investments than dairying especially in recent times. One of our first investments on the stock market was the money from the sale of some of the silage equipment. We sought advice and this was invested in the Irish Stock Market. In the first 2 months, it made 50% then fell, then came back. It is volatile but if we invest in good companies with a good track record over a long period of time we should do well. Since then we have learned more of what to look for in selecting shares to invest in. Completed a course in investment principles has helped us in this regard.

Last winter when the cows were dried off I went to work in a shop to learn the business. It was a great experience. We believe that if we are going to invest in something we need to research and know the business, also we will pay for professional advice where needed.

Conclusion

Farming is and will continue to be the backbone of our business. The business is efficient, but due to lack of opportunities in agriculture outside investments are attractive (assuming we invest long term). We will continue investing outside agriculture until opportunities arise in agriculture, which will give us a good return on our investment.

References:

McCarthy, D (2000). Optimising profits on dairy farms. *Dairying 2000 - Opportunities for the new millennium.* Teagasc National Dairy Conference, Cork.

Plan and key points to successfully growing your business

COLIN ARMER
Tepuke, New Zealand

New Zealand (NZ). Famous for lamb, butter, beer and the All Blacks. Unconstrained by quotas, and unprotected by subsidies, dairy farmers live and die on their ability to make a profit on the world market. In 2000 NZ had more than 14,000 dairy farmers working an average 90 ha (222 ac) of land. On these 90 ha the farmer produced some 60 tonnes of milk solids from 230 cows. A temperate climate facilitates grazing cows all year round, with the cows being dried off during the winter. Milk goes to The Co-operative dairy company (of which the farmer is a shareholder) and 95 per cent of this milk is processed for export. That was farming in NZ. Today we are looking at the new face of farming.

New Zealand farmers of the future will become even more efficient at producing milk solids. It's something we do very well. In less than 23 years my wife Dale and I have moved from farm labourers, to share milkers running 150 cows, to farm investors owning and running 11 farms. Today we own 10,000 cows in NZ's North Island. Ten years from now our colleagues will be those that made farming their business, and grew that business to capitalise on the economies of scale. The rest will have sold up and moved to the security of the cities – there's no room for complacency in today's dairy industry.

What is the key to success? There's no secret formula. It's all a matter of profit. We took under-performing farms and turned them into cash cows. Once that farm is established and generating money we move on to the next farm. It's a system that once set in motion generates its own momentum. We see dairy farming as a simple process. **Grow as much grass as possible turning most of it into milk, all the time keeping a close eye on costs and the balance sheet**.

Growing grass

Grass is the great renewable resource. Farming is all about growing grass, yet many farmers consistently fail to maximise production of this resource. Growing grass is one of the simplest ways to grow productivity, and using fertiliser is the key. In fact it's one of the few things that NZ farmers will spend money on. We soil test on a yearly basis and develop a short-term fertilising strategy to optimise the soil's nutrient levels. Land is contoured, drained and reseeded to support intensive grazing as needed. The aim is to turn as much sunshine as possible into grass. This means removing any limiting steps such as nutrient deficiency, unsuitable grass types, or waterlogged land. Delays in applying fertiliser simply delay the production response, and therefore the farm's profitability. Every additional tonne of grass that is grown can be turned into 57 kg of milk solids. Growing grass creates the potential to grow your business.

Growing cows

To efficiently turn grass into milk we need a cost-effective animal management programme. This means reducing animal wastage and maximising herd growth. In NZ (as in Ireland), fertility problems are associated with U.S. Holstein Friesian genetics. However, by using semen from NZ Jersey bulls and a cross breeding programme, 95 % of cows go in calf every year. Using bulls from a sire-proving scheme ensures value for money. By retaining as many cows as possible and achieving high pregnancy rates, NZ farmers are constantly growing their demand for grass.

Growing productivity

Stocking the land is the next step. Put simply cows add value to grass by turning it into milk. In NZ it is possible to grow about 14 t of grass for every hectare of land. Most farmers are content to use 75 % of their annual grass production, but by carefully stocking our farms it is possible to get cows to eat 85 % of the grass produced. By maximising grass production and then getting cows to utilise as much of that grass as possible, annual income can be significant increased.

For example: - take a farmer growing 12 t grass/ha. The farmer is content to use 75 % of this grass, which equates to 9 t of grass. His cows turn each tonne of grass they eat into 67 kg of milk solids making 600 kg of milk solids in total. At IR£1.50/kg this represents a gross profit of IR£900/ha/yr. Alternatively, by optimising soil fertility and grass type the same land is now capable of producing 14 t of grass, of which the cows eat 85 % or about 12 t/ha/yr. From this the cows produce 800 t of milk solids worth IR£1,200 – nearly 35% more income. By efficiently managing our pastures, and matching annual growth to consumption, we don't need to buy in expensive feeds. This contrasts with many farmers who write out cheques for winter feed while their grass goes to waste.

Growing debt

It can be argued that this comes at a capital cost. However it makes economic sense to borrow the money up front so it can be immediately used to improve the fertility of your property, rather than relying on an under-performing farm to progressively fund a series of five-year improvement plans. It didn't work for Chairman Mao, and it doesn't work for farmers. Add into this equation the simple fact that cows appreciate in value – they spit out a new calf every year – and you will see that higher stock rates mean a faster growth in livestock assets. The key to growing your business is to do it with somebody else's money. I'm a strong believer in debt. I don't believe in sinking vast reserves of my own capital into a farm. A well-run farm will generate enough money to service a mortgage, make capital repayments plus provide a surplus for further expansion. High gearing facilitates the establishment of a farm with minimal direct investment, which quickly begins to generate additional capital for further expansion.

Farms are converted using as much of the bank's money as possible, and as little as possible personal cash. This is achieved by using our own cows to stock new farms. Typically such cows represent three quarters of the assets brought to a new venture, the other quarter being cash spent on capital improvements to get the grass growing. This means the 70 % loan from the banks (the maximum amount on offer in NZ) often equals the original cost price of the farm, or in other words a 100 % gearing on land and building costs.

Growing a business

So much for the theory. How do we apply these principles to growing the business? In June 2000 I borrowed IR£1.3 million to buy a 275 ha farm in NZ, and introduced new management and staff that understood our production techniques and followed our cost-control measures. We applied appropriate levels of fertiliser, and stocked the farm using 1,000 cows, which were raised surplus to our other operations. By growing more grass and increasing utilization, we increased pre-conversion production by 40 %. This shift in production increased the capital value of the farm to IR£1.9 million. Thus within a year we had created a farm with a total value including livestock of IR£2.2 million. To do this we had borrowed IR£1.3 million, added 1,000 cows which were surplus to our other holdings, and invested personal money to improve the soil and sward. The return on this operation pays all costs, all interest payments, repayment of the debt, plus it generates enough additional capital to fund future expansion. What's more the cows are producing calves, which can stock future farm purchases.

Some may argue that we're building a house of cards. That our high gearing is a formula for failure. The important point is that every one of our farms is a viable unit. Each farm is servicing its debt and generating additional revenue which we use to grow our business. We are not funding our expansion by relying on potential revenues. Rather we're converting farms into highly-productive units which are generating real profits. We then use these profits to grow our business. The reason why we continue investing in new farms is that NZ still offers considerable scope to generate spectacular profits by converting both sheep, beef, and under-performing dairy farms into highly-productive dairy units. While these opportunities for expansion might not be so evident in Ireland, I believe our farming philosophy can still be applied to generate considerable revenue from your farms, which can then be applied to expand your other business interests.

Keeping a tight reign on debt

While I've said that we love debt, we are very careful where we spend our money. In fact tight financial control is a cornerstone of profit making. I believe in spending money where it's going to make money. Where there is a need for capital investment I look to the cheapest option for getting the job done. In a recent farm conversion we had to build a new farm dairy. By opting for an open-sided dairy we managed to keep costs down to IR£45,000. A conventional farmer may well have spent IR£180,000 building a Rolls Royce dairy. Our dairy is doing the same job at a quarter of the price, but in contrast to the conventional farmer there is still IR£135,000 in the kitty to grow the business.

Farm implements are another area waiting to consume capital. Agents are always willing to peddle the latest machinery guaranteed to improve productivity - impressive monuments of painted metal and stainless steel. Let somebody else own it. Every dollar spend on machinery is a dollar less to improve productivity. Remember a simple phone call is enough to get a contractor beating a path to your door. The more money invested in farm machinery, the higher the running costs and the greater the depreciation and maintenance costs. Our adage is – **'if it works, use it; If it doesn't hire it; if you can't hire it buy the cheapest option'**. Put simply: less four-wheeled vehicles, more four-legged animals.

Animal health is another area, which can soak up profits. While we're all in favour of maintaining a healthy herd, this does not mean applying every last medical breakthrough to your cows. Carefully assess new animal husbandry practices, and select only those that add significant value to the herd.

Looking beyond the farm

Carefully scrutinising capital outlay is an obvious way to control costs, but it is also prudent to look beyond traditional farming practices to seek new ways of growing the business. The corporate world provides plenty of examples, and in the corporate world the mantra is to concentrate on your core business. Growing grass and getting cows to turn that grass into milk solids is our core business. We want to make this process as efficient as possible. We don't want to waste our quality pastures raising calves. Calves don't turn grass into milk. That's not to say that we don't like calves. As was said earlier cows are a great investment because they appreciate in value. In fact 95 % of our cows calf every year, but then we want to get our calves off our farms as quick as possible. To do this we wean them early and feed them on pellets and straw on a centralised calf farm. This system is a labour-efficient means of rearing new livestock and saves our pastures for milk production. One full-time worker with occasional casual labour raises 2000 young calves each year. As the animals grow they are moved onto one of 12 leased farms that used to run sheep and beef.

Leasing ex-sheep farms is an inexpensive means of building grazing capacity. Leasing land is not only cheaper than paying a grazing fee to other farmers, it also facilitates control over how our calves and heifers are raised. This land is perfectly adequate to raise calves, which means we don't have to take our premium pastures out of milk production. **Remember our core business is turning grass into milk**. Currently we are using calf-rearing sheds and leased farms to raise 5,000 calves. This highly efficient and cost-effective way of raising new herds produces assets, which feed into our farm expansion programme.

Controlling labour costs

Our calf-rearing programme is but one example of how we control labour costs, with economies of scale providing many more opportunities. Applying innovative growing techniques and hiring rather than buying specialist machinery, means our farms use minimum labour. Efficient grass utilisation is the best way to reduce labour costs. It is cheaper to hire a contractor to fertilise land than to pay staff to run an intensive supplementary feed programme. Labour, like all other costs, must justify its expense. Therefore it is expected that all of the people employed add value to our operations.

Currently we employ 65 people. Keeping staff motivated means offering clear job descriptions and channels for advancement. A simple and clear management structure is also important to aid the flow of communication and clearly define who is responsible for accomplishing each task. If possible staff are encouraged to purchase a few cows on a lease arrangement. Providing staff with a stake holding in operations can prove a powerful motivator. Encouraging staff to undertake adult education programmes is another way to add value to their work. This applies equally to management - both Dale and I continually question how we operate and are continually seeking new solutions. We have found inspiration from innovative thinkers, both in farming and from other sectors of industry. This does not mean paying for costly consultants, but rather trusting our own curiosity and judgement to select those procedures likely to add significant value to our operations. The only area where we do pay for specialist advice is on legal and accounting matters to ensure our operations comply with our legal obligations and operate in a tax-efficient manner.

Key steps to controlling costs:

- Question money spent on animal health, breeding and herd testing. Don't let your heart rule your head, apply simple cost-benefit criteria every time money is spend on the herd.
- Question the money spent on capital improvements – don't compete with the neighbour for the most attractive farm, compete where it counts, on making money.
- Control labour costs – look for economies of scale, and reward staff for a job well done, not for complacency.
- Look for alternatives – treat farming like any other business, it should be continually improved, standing still means you're going backwards.
- Seek expert advice – consider yourself an expert on turning grass into milk, and seek advice from others to fill in the necessary knowledge gaps.

Investment criteria

Investing in production while controlling other costs has proven a successful formula to fund expansion. However, moving from being farmer to a farm investor means developing a strategy to manage growth. Three years ago we set ourselves an investment strategy to manage our cashflow, plus most importantly the allocation of our time. The merits of each new project were judged on three criteria:

- Minimum 13 per cent return.
- Positive effect on equity.
- The project will consume **one day's work per week** for the first year, then **one day per month** thereafter.

As operations have grown we have refined these criteria to:

- Minimum 13 per cent return.
- **Very** positive effect on equity.
- The project will consume **half a day's work per month** for the first year, then **one hour per month** thereafter.

It is anticipated that in three years, our time available to manage investments will become even more limited. I don't believe in expanding operations at the expense of free time. Careful time management is very important for the successful expansion of our partnership, and the Internet is a powerful tool to manage our holdings.

Picking winners

To meet our investment strategy we had to select farms ripe for conversion. Often this meant looking beyond traditional dairying areas. Marginal land often provides the greatest potential for positive shifts in equity. We have a proven history of converting peat land to highly productive pastures. Recently we looked at 1000 ha of high-country land that was running sheep. The land was primarily flat with high summer rainfall, but suffered from severe winters, poor soil fertility and no ryegrasses. These factors meant it was not considered suitable for dairy farming. In fact the nearest dairy farm was some 70 km away. While we couldn't control the weather, we were confident that reseeding and fertiliser would produce quality pastures. We could then deal with winter grazing by leasing sheep farms near the coast. Add this to the lack of competitive interest by other dairy farmers, and this land was ripe for conversion. We saw it as marginal land that could be converted into quality pastures.

Unfortunately our bank manager didn't share our vision. One of his Wellingtons is still standing in the paddock. He left it behind in his haste to walk away from the venture. We haven't bothered returning it - in fact we haven't seen him since. We simply selected a bank that was willing to share our vision. The property was bought and converted using our proven business system. Within six years we tripled production with 3500 cows annually producing one million kg of milk solids. High productivity has resulted in a high shift in equity as the land is now valued as a productive dairy farm, and not as a low-return sheep unit.

In 23 years we have moved from farm labourers to farm investors. By applying a low-cost high-profit approach to farming we have progressively brought 11 farms in NZ central North Island and run some 10000 cows. The capital value of these operations is IR£22 million.

The power to expand

The profits generated from our 11 dairy farms have recently provided us with the capital resources to enter a new phase of expansion. In partnership with three others we have recently brought 33 farms in NZ's South Island. The area, known as Canterbury, is experiencing a financial boom as progressive investors begin converting sheep and beef land into highly productive dairy farms. Our company (Dairy Farm Holdings) manages some 25000 cows producing some nine million kg of milk solids each year. Productivity will rise and costs will fall as we apply our farming methods to grow ample grass, and then turn as much of that grass as possible into milk solids.

Our eye for a good investment is now looking beyond NZ. Using the same partnership we have just secured a 50 per cent stake in a group of Australian farms. Tasman Agriculture is a listed public company trading on NZ's stock exchange. The company owns and operates a number of farms in Australia running 15000 dairy cows along with sheep and beef. We are more than confident that our conversion programme will see the production of high-quality grass, which will support pure dairy farming. In combination these holdings represent an IR£85 million investment in the future of the world dairy industry.

Getting it right

What set the platform for this exponential growth? It's all built upon growing as much grass as we can, then turning as much of that grass as possible into milk, all the time keeping a close eye on costs. All we are doing is applying the KIS principle to farming - **Keep It Simple**. It works! A well-run dairy farm will generate considerable profit for ploughing back into expanding the farm holdings. We have done this because we see considerable potential for gains in New Zealand and Australia. However, the profits can be equally

Leptospirosis in dairy cows – what are the solutions?

N. LEONARD
Department of Veterinary Microbiology and Parasitology, Faculty of Veterinary Medicine, UCD, Dublin 4

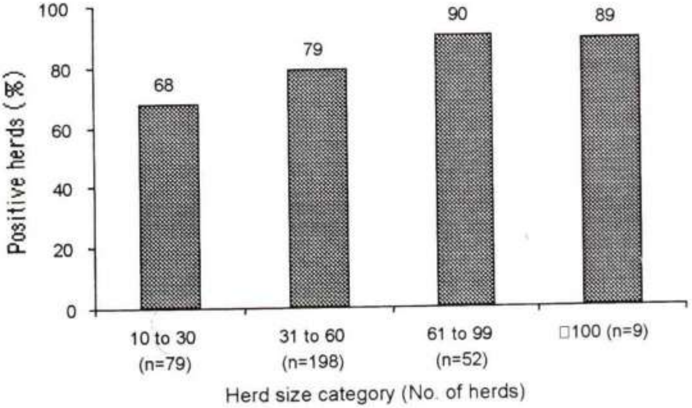
Introduction

Leptospires are thin, helical bacteria which survive well in moist conditions. There are many species of leptospires, many of which do not cause disease. Pathogenic leptospires persist in the kidneys of their natural hosts and may be excreted in urine for months or years. In Ireland, the cow is the natural host for two species of leptospires, *Leptospira interrogans* serovar *hardjo* and *Leptospira borgpetersenii* serovar *hardjo*. Both organisms are similar in their effects and most diagnostic tests do not distinguish between them. Genetic fingerprinting can differentiate them but this is usually done only in research laboratories. There is evidence that *L. interrogans* serovar *hardjo* may be more pathogenic than *L. borgpetersenii* serovar *hardjo* but the latter is more widely distributed throughout the dairy cow population. The principal relevance of this is in relation to vaccine manufacture.

The effects of leptospiral infection

Infection with serovar *hardjo* is widespread in Irish dairy cows. A recent survey of dairy herds using a bulk milk tank ELISA test showed that 79% of unvaccinated herds contained animals, which had acquired infection within the previous 12 months (Leonard *et al.*, 2001). Larger herds were more likely to be positive for infection (Figure 1).

Figure 1 Proportion of different herd size categories with positive *Leptospira hardjo* bulk tank milk samples.



Clinical effects in cattle

The effects of leptospirosis in a dairy herd can be dramatic if it is introduced into a previously uninfected herd with a high percentage of animals aborting. Animals may also show milk drop syndrome in which there is sudden loss of milk production, usually affecting all four quarters. The udder is soft and flabby and the milk is thickened like colostrum. Return to normal milk production within about 14 days is usual. Diagnosis of leptospiral disease in Irish regional veterinary laboratories is usually based on detection of high antibody titres in serum and reports from the laboratories indicate that high titres are detected regularly following investigation of abortions. However, as the results of the survey by Leonard *et al.* (2001) show, leptospiral infection is now endemic in most Irish dairy herds and thus few animals show clinical signs of disease because most animals in the herd are immune. Animals most likely to show clinical signs are those newly introduced to the herd such as replacement heifers, which have had no previous contact with the main herd or bought-in animals. Bennett (1993) calculated the costs of endemic infection with leptospirosis at between £1,300 and £3,300 Stg in a 100 cow herd. Losses can be attributed mainly to loss of milk production, abortions and reduced herd fertility. Dhaliwal *et al.* (1996a,b) showed that herd fertility is reduced in herds in which cows have recently acquired infection with serovar *hardjo* and that vaccination may be beneficial in improving fertility in infected herds.

Clinical effects in humans

In addition to losses due to animal disease, leptospirosis can affect humans. Humans can acquire leptospirosis from contact with urine of infected animals. The most serious form of leptospirosis is carried by rats and causes Weil's disease in people. However, serovar *hardjo* can also infect humans and causes influenza-like symptoms. A recent paper by Pate *et al.* (2000) stated that the mean number of hospital-reported cases of leptospirosis in Ireland was 4.9 per million per annum during the years 1990-1996, which is approximately 5 times higher than the incidence in England. The highest incidence of disease was in the South-Eastern Health Board at 10.4 cases per million per annum, almost one third of which were due to serovar *hardjo*. A significant association with numbers of cattle and annual incidence of leptospirosis was detected and increased uptake of cattle vaccination was suggested as a possible means of reducing the number of human cases of disease.

Leptospirosis in dairy cows – the solutions

A number of options are available for coping with leptospirosis in a dairy herd:

Live with infection

The first option is to live with the infection and implement no control measures. Most herds are endemically infected with leptospirosis and thus a high proportion of animals in the herd are immune and it can be expected than only a small percentage of animals will show signs of disease. It has been estimated that the abortion rate due to leptospirosis in endemically infected herd's ranges between 3% and 5%. However, the abortion rate may be less in some herds and prediction of effects is difficult due to a lack of data and apparent variation in pathogenicity between strains of *hardjo*. Equally, as immunity in a herd wanes, mini-outbreaks of disease are possible and abortion rates may rise above 5%. The risk of human infection in endemically infected herds is relatively low as only a small proportion of animals are actively infected and shedding leptospires in urine. However, health and safety regulations mean that such risks cannot be dismissed and employers must act responsibly in relation to the health of farm workers.

Vaccination

There are a number of vaccines on the market in Ireland. All are killed vaccines although there are differences in formulation between them. Not all vaccines contain the same strains of serovar *hardjo* but unfortunately no comparative data are available on the performance of the vaccines currently available in Ireland. All vaccines require a primary course of two injections 2 to 6 weeks apart; the interval between doses varies depending on the product used. Booster vaccination is carried out annually. The recommendation is that vaccination should be completed in the spring, before the main season of transmission of serovar *hardjo* infection. As there is some evidence that vaccination may have a transient effect on conception rates, it is recommended that vaccination be completed two weeks before the beginning of the breeding season in spring-calving herds.

Treatment with antibiotics

Antibiotic treatment can be used as a tool in the control of leptospirosis, principally for the elimination of shedding of leptospires in urine but also to minimise abortions in herds experiencing outbreaks of infection. Treatment of pregnant animals with antibiotics helps to prevent damage to the placenta and subsequent abortion in infected animals. Dihydrostreptomycin at a dose rate of 25 mg/kg is the antibiotic usually recommended for treatment but amoxycillin at 15 mg/kg may be a useful alternative (Smith *et al.* 1997).

Control regimes

The pattern of infection in a herd can be established by blood sampling and testing of appropriate numbers of animals in conjunction with the herd veterinary surgeon. A bulk milk tank ELISA test is also now available and can be a useful initial screening test. Once the extent of infection in a herd is known, the most appropriate control regime can be selected. Detailed guidelines on methods for the control of leptospirosis have been published (Anon, 1992). Vaccination does not prevent previously infected animals from shedding of leptospires in urine.

Whole herd vaccination with annual boosters in the spring is a commonly employed control method in endemically infected herds. Provided no major risk factors are present such as frequent introduction of animals into the herd, annual vaccination should be adequate. Vaccination of replacement animals should be started at 6 months of age. It is important to include bulls in a vaccination control programme as the effectively transmit infection. Bulls or other animals introduced to the herd should be treated with dihydrostreptomycin, vaccinated and held in isolation for approximately a week before introduction to the herd. (A quarantine period of a number of weeks may be required for the control of diseases other than leptospirosis).

Partial herd vaccination appears to give adequate protection in herds in which no major clinical signs of leptospirosis are detectable, although in theory, outbreaks of disease in older animals are possible. This option involves vaccination of replacement stock at 6, 18 and 30 months of age. Bulls should be treated as detailed under whole herd vaccination.

Vaccination can be combined with antibiotic treatment in herds in which many animals have been clinically affected with leptospirosis, or if elimination of urinary shedding is required to reduce the risk of human infection. Antibiotic treatment of a herd, in combination with simultaneous vaccination of at least all cows in the second half of pregnancy is effective in reducing losses in the face of an abortion storm. As the dose rate for dihydrostreptomycin requires milk to be discarded for at least 7 days, it may be more economical in some herds to delay treatment until drying off. For logistical reasons, this is most feasible in herds with short calving periods as treated animals must be kept separately from untreated animals for as long as possible until all shedding in urine has ceased.

Eradication of infection in a herd

It is possible to eradicate leptospiral infection from a herd and a scheme under which herds may achieve leptospiral 'elite' status has operated in the UK. Herds, which show only a few animals serologically positive at a low level on herd screening, could attempt to eliminate infection from the herd. This can be achieved by treating all positive animals with antibiotic, retesting to establish that the animals have become serologically negative and using regular serological monitoring to ensure all animals in the herd remain serologically negative. All additions to the herd must be serologically negative, treated with antibiotic and held in isolation before joining the main group of animals. Control of other known risk factors such as access to rivers or co-grazing with sheep must also be possible. An individual herd-owner and his veterinary surgeon must assess the practicality and economic implications of achieving and maintaining herd infection-free status.

References:

Anon (1992) Guidelines for the diagnosis and control of *Leptospira hardjo* infection in cattle. *British Cattle Veterinary Association*, UK

Dhaliwal, G.S., Murray, R.D. and Ellis, W.A. (1996) Reproductive performance of dairy herds infected with *Leptospira interrogans* serovar *hardjo* relative to the year of diagnosis. *Veterinary Record* **138** 272-276.

Dhaliwal, G.S., Murray, R.D., Dobson, H. Montgomery, J. and Ellis, W.A. (1996) Effect of vaccination against *Leptospira interrogans* serovar *hardjo* on milk production and fertility in dairy cattle. *Veterinary Record* **138** 334-335.

Leonard, N., Mee, J.F., Snijders, S.E.M. and Mackie, D. (2001) Prevalence of antibodies to *Leptospira hardjo* in bulk tank milk: samples from unvaccinated Irish dairy herds – interim survey results. Unpublished report.

Pate, G.E., Hogan, M.C., FitzSimon, N. and Mellotte, G.J. (2000) A review of the epidemiology of leptospirosis in the Republic of Ireland. *Irish Medical Journal* **93** No. 4.

Smith, C.R., Corney, B.G., McGowan, M.R., McClintock, C.S., Ward, W. and Ketterer, P.J. (1997) Amoxycillin as an alternative to dihydrostreptomycin sulphate for treating cattle infected with *Leptospira borgpetersenii* serovar *hardjo*. *Australian Veterinary Journal* **75** 818-821.

Salmonellosis in cattle – your questions answered

J. F. MEE
Teagasc, Dairy Production Department, Moorepark Production Research Centre, Fermoy,Co. Cork.

Salmonellosis in cattle is becoming an increasing problem on intensive Irish dairy farms with an upward trend in outbreaks over the last decade. Over 2000 different serotypes of salmonella exist. However two, *Salmonella dublin* and *Salmonella typhimurium* account for 80 to 90 % of salmonella infections in cattle (McIlroy et al, 1990). Hence, this paper will concentrate on these two important serotypes. In Ireland, *S. dublin* is the most prevalent type infecting cattle.

Q. How would I know whether my herd is infected?

Clinical signs are the first indicators of infection. Salmonellosis demonstrates a distinct seasonal prevalence with the majority of cases occurring during the winter and spring, reflecting the temporal distribution of calvings.

Abortion

With *S dublin*, the typical sign is sporadic mid to late term abortion or an abortion storm. This usually occurs without any other signs of disease (Hinton, 1974; Choo, 1989), although retention of the placenta is common. Abortions usually occur around the seventh month of pregnancy. Cases may occur as early as the fourth month of pregnancy right up to full term. The peak incidence of salmonella abortions occurs between October and December. While there are numerous causes of sporadic abortions, salmonella infection along with leptospira and neospora infections, are the main causes of multiple abortions. Foetuses aborted following salmonella infection are likely to be decomposed, as the interval between infection and abortion is approximately a week. Older cows are more likely to abort. Herds affected are typically large, closed herds where the owner recognised that there was an infectious disease problem (O' Reilly and Egan, 1988). Stillborn, premature and full term infected calves may also be delivered.

In order to establish whether an abortion in your herd was caused by salmonella infection, you need to submit the foetus for post-mortem examination. A single blood sample from the aborted cow may not be diagnostic. A recent study showed no difference in the prevalence of antibodies to *S. dublin* in single blood samples from aborted compared to non-aborted cows in Irish herds (Meleady *et al*, 2000). The authors stated that the blood test (SAT) is not the most sensitive test and should only be used as an adjunct to culture of the organism. Submission of the foetus, preferably with the placenta and a vaginal, faecal or milk sample from the cow may also assist diagnosis of other causes of abortion. Unfortunately, a recent report indicated that only about 13% of all bovine abortions are investigated by submission of material to the local veterinary laboratory (Anon. 1999). Recent figures from the Department of Agriculture Food and Rural Development indicate that salmonella infection is the most commonly diagnosed cause of abortion in cattle (Table 1). The increase in incidence of salmonella abortions between 1999 and 2000 (Limerick RVL: 17 to 37%) was attributed to wet weather, heavy fluke infestation, poor nutrition and the shortage of vaccine (Anon. 2000). Some calves infected in the last month of pregnancy will survive to term and can perpetuate the cycle of infection in later years on the farm. Newborn calves may be infected by suckling milk from infected cows or from contaminated bedding.

Table 1: Bovine abortion results from the six DAFRD veterinary laboratories (1999-2000).

Abortifacient	No. abortions	**% positive**
Salmonella dublin	402	10.2
Neospora caninum	111	8.1
Brucella abortus	319	6.9
Leptospira hardjo	180	6.6
Fungal species	224	3.6
Actinomyces pyogenes	234	3.0
Listeria monocytogenes	152	1.3

Source: Irish Veterinary Journal, (2000), 53:75 and (1999), 52:614.

Diarrhoea/dysentery in adult cattle

Outbreaks of diarrhoea (with or without blood or casts of the bowel) in adult cattle should raise suspicions of salmonellosis. Initial cases may present with vague signs such as 'just not doing well since calving'. Affected cattle (often only one or two initially), will run a high temperature, have foetid, watery diarrhoea, refuse feed and have a sudden fall in milk yield. Subsequently, animals will appear dull and lethargic with sunken eyes and loss of body condition developing. *S. typhimurium* is more likely to cause these signs than *S. dublin*. Clinical signs may resemble mucosal disease but are more sudden in onset. Abortion is not usually an accompanying problem. Outbreaks are often associated with the stress of calving and onset of lactation and many cows can be affected over a short period. Cows can become seriously ill and despite intensive veterinary care, losses can be high. Mortality rates of up to 40% have been reported. In general calves in infected herds are not similarly affected.

Diarrhoea, pneumonia, meningitis, joint-ill, gangrene in calves

Salmonella infections in calves are typically caused by *S. typhimurium* but *S. dubin* can be involved on dairy farms (Greene and Dempsey, 1986). Calf problems are often not accompanied by abortion in cows, but there may be a previous history of abortion. Unlike nutritional diarrhoea, salmonella infection can cause severe diarrhoea, with calves becoming ill very quickly. Mixed infections with other organisms also occur. In cases of septicaemia, where the bacteria enter the bloodstream, calves may be found dead within days of calving, without other signs. More often, affected calves are a few weeks of age and a number are affected together. Severe pneumonia may accompany the diarrhoea or be a separate syndrome, often with other respiratory infections. Cases of salmonella, meningitis and joint-ill are usually sporadic. Following an outbreak of salmonellosis in calves, a number of the survivors, often too stunted to sell, will develop osteomyelitis of the limbs or neck vertebrae or dry gangrene of the ears, tail and lower limbs (Power and O'Keefe, 1991, Mee, 1995).

Q. Could my herd be infected without these problems?

Yes. Infection is not synonymous with disease. In the case of *S. dublin*, which is host-specific, carrier cows can maintain latent infection within a herd for years without clinical signs. One asymptomatic carrier cow can shed over 10 billion *S. dublin* organisms per day into the environment (Smith and House, 1992). As the stress and metabolic changes at calving may precipitate excretion, this is the best time to attempt to detect carriers. However, few cows which abort due to *S. dublin* continue to excrete salmonella at the subsequent calving (Aitken, 1987). Excretion of *S. typhimurium* usually only lasts for weeks to months, but environmental contamination is important in maintaining infection, for over five years in some cases (Wray et al., 1989). Disease may only be activated following stress such as upon housing, calving, feed shortages, outwintering in inclement weather, overcrowding towards the end of the calving season or transport of calves.

Detection of carrier animals is difficult as they may shed salmonella in their faeces intermittently. Hence, frequent milk (Giles and King, 1987) or faecal culture of individual animals is required (van Duijkeren *et al.*, 1995). If salmonella were shed by 5 % of cows in a herd, to have 90 % certainty of detecting the organism in at least one cow tested, it would be necessary to test 37 cows. Blood samples may also be examined for SAT antibodies to salmonella but titres in chronic carriers may be low. ELISAs have now been developed, for both blood and milk, which predict carrier status using two samples two months apart and facilitate herd screening (Hoofar and Bitsch, 1995; Spier *et al.*, 1990).

Q. How can I prevent infection getting into my herd?

Salmonella can enter a herd in livestock, feed, water, wildlife, birds, humans and vehicles, or may be airborne. Most likely modes of transmission are via carrier livestock and wildlife (Evans and Davies, 1996).

To prevent entry via carrier livestock you need to maintain a closed herd policy, avoid direct animal-to-animal contact with neighbouring cattle and isolate animals returned unsold from the mart or purchased animals. There is no evidence of venereal spread of infection. Wild life vectors (rodents, badgers and foxes), (Humphrey and Bygrave, 1988; Euden, 1990), domestic and wild birds (seagulls, pigeons, starlings, swallows, crows, geese) and domestic pets (cats and dogs) may transmit salmonellae. These vectors can act as long-term reservoirs of infection. Droppings containing *S. typhimurium* can contaminate feed stores, feed troughs and water troughs (Eld, *et al.*, 1991; Johnston, *et al.*, 1979; Warnick, *et al.*, 1995). It has been suggested that the proximity of a sewerage treatment plant or landfill dump may increase this risk (Crilly, 2000a). Covering feed and water troughs (where practical) may reduce this risk along with installing netting and removing nests of wild birds from feed sheds and animal accommodation. While *S. dublin* and *typhimurium* are not commonly associated with feedstuffs, other salmonella species may be present (Eld, *et al.*, 1991). With the removal of animal proteins from feedstuffs this risk is greatly reduced. Most isolates are now found in wheat or other cereal ingredients, largely caused by wild bird and rodent droppings (Davies, 2001).

Q. Immediately infection has been detected in my herd, what should I do?

A presumptive veterinary clinical diagnosis will precede the laboratory diagnosis of salmonellosis. Therapy will be based on the tentative diagnosis and may be revised depending on the results of the laboratory diagnosis and antibiotic sensitivity results. Because the course of the disease can be unpredictable, ranging from a single case to an outbreak, prompt, intensive veterinary therapy is advisable in all suspicious cases. Hygiene practises should be upgraded including installation of footbaths near affected housing.

1. Abortion.

In the case of an abortion, it may take a week before a laboratory diagnosis is confirmed. In the interim other cases may occur, particularly in seasonally calving herds where herd-mates are at a similar stage of pregnancy. In such cases the aborted animal should be isolated, samples submitted to the laboratory, the contaminated bedding destroyed and more frequent observations conducted on the remaining pregnant animals in the group. Where one animal has aborted due to salmonella infection, it is likely that other pregnant animals are infected. Whether they abort or not may be determined by the extent of the infectious challenge, the degree of immunity and the level of environmental stress. If the placenta and foetus are already infected, irreversible toxaemia and lesions may be present that will lead to foetal mortality and abortion, irrespective of what control measures are adopted. However, some of the in contact animals or animals in other groups may not be infected at the time of the first abortion.

In a situation where a salmonella abortion has been diagnosed, attempts can be made to protect other pregnant animals by implementing a vaccination regime. As there is now a product license for such an indication, this policy has been recommended by the manufacturer in the face of a potential outbreak. Empirical advice is to use three doses of vaccine at ten day intervals in the face of an outbreak (Roche, *pers. com.*). Experience with vaccination in the face of an outbreak has resulted in variable responses (Davies and Renton, 1992; Hunter and Peek, 1977; Mee and Malone, 1995). Poor responses may be due to prior infection in the placenta and foetus of pregnant animals and the delay before an immune response to the vaccine is protective (two weeks after the second dose of the primary vaccination course). However, prevention of secondary outbreaks has been attributed to vaccination in the face of the primary outbreak along with other control measures (Hunter and Peek, 1977; Hatch, 1974).

Preventative antibiotic treatment (injection or bolus) of 'at-risk' dry, pregnant cows may theoretically reduce the infection level in animals in the short-term. However, this will not totally eliminate excretion of salmonellae by carrier animals. In-contact animals will still be susceptible to re-infection and there is a risk of antibiotic resistance developing.

Treatment of 'at-risk' pregnant, dry, or lactating animals with a polyvalent sero-vaccine (eg. Grovax, Intervet Ltd.) may provide immediate protection against infection in the short-term and increase immunity in the long term following a booster dose of vaccine (eg. Bovivac S, Intervet Ltd), (Davies and Renton, 1992). Whether this regime is cost-effective given the variable risk of further abortions and product cost has not been established.

2. Diarrhoea/dysentery in adult cattle.

Following treatment of clinically affected animals, vaccination of all at-risk animals twice at a three-week interval and affected animals upon recovery is advised to reduce excretion and to prevent secondary outbreaks (Robinson, 1997). However, because animals with diarrhoea will have contaminated their environment with salmonellae, water and feed troughs may need to be emptied, disinfected and raised to prevent re-contamination. Bedding will need to be removed and destroyed.

Salmonellosis in calves.

In the face of an outbreak, antibiotic therapy and sero-vaccine can be used along with supportive electrolyte and other therapies. The recent appearance of a multi antibiotic resistant strain of *S. typhimurium*, type 104, has made choice of antimicrobial even more important (Davies, 2001). Where contamination of the calf accommodation is likely to have occurred, hygiene and disinfection are important to reduce the on going risk of transmission. For example, salmonellae can be transmitted via saliva on poorly washed calf buckets. As salmonellae can also be transmitted via air borne infection within accommodation, different age groups should not be housed together. Clinically affected calves, particularly those with pneumonia, should be isolated from healthy calves. Vaccination of calves can be commenced after three weeks of age with a booster dose within two to three weeks. Modern live salmonella vaccines can significantly reduce mortality in field outbreaks (Selim *et al.*, 1995), but other studies have failed to show a benefit to routine vaccination (Tyler *et al.*, 1999). Depending on how compact the calving season is, it is advisable to vaccinate pregnant cows at six to eight and three to four weeks pre-calving. This will boost salmonella-specific colostral antibodies thus providing passive protection to calves by reducing both excretion and losses.

Q. In the long-term how can I reduce my risk from salmonellosis?

As not all herds are at equal risk of infection, particular circumstances must be factored into the guidelines issued. For example, recent international data indicate a significantly higher risk of salmonellosis in large compared to small herds (Warnick *et al.*, 1995). Enterprise type affects risk. Data from the UK indicates that calf rearers are more likely to have problems with salmonellosis than other enterprises. Risk may also vary from year to year, being higher in wet years when inclement weather, underfeeding and possibly liver fluke infection can increase the incidence of disease.

Closed herd.

This most basic biosecurity measure can be difficult to implement where culling rates are high or a stock bull is purchased. However, it does prevent access of a carrier animal and reduces risk from livestock vehicles. In the UK, a four-fold higher risk of *S. typhimurium* infection was associated with purchase of animals from dealers compared to other farms (Evans and Davies, 1996). When animals are purchased, ideally they should be sampled upon arrival and maintained in quarantine until results are clear. Where cattle must be purchased, direct purchase from herds with a salmonella-free status will reduce risk. Unnecessary visitors should be discouraged as salmonella can be transmitted on footwear.

Boundary fencing

Avoiding direct contact with neighbouring animals reduces herd-to-herd transmission.

Feed and water hygiene

Access to feed stores by rodents, cats, dogs and wild birds should be restricted. For example, using bait stations to reduce rodent numbers and netting to restrict access by birds. Water bowls and troughs that either have protective lids or are high enough to prevent faecal contamination reduce the risk of spread. Stagnant water and areas likely to flood should be fenced off. Slurry should be spread on arable land or on land not to be grazed for at least a month.

Accommodation hygiene

Calf-to-calf spread can be reduced by removal of bedding between batches of calves, and maintaining adequate drainage. Ensure calves lie up on the bedding and not near the water troughs, feed troughs or milk nipples by providing bedded and un-bedded areas in group pens. Salmonella can survive for at least six years in buildings in dried faeces (Plym-Forshell and Ekesbo, 1996) and for months on pasture. It has been found that using a power washer without first removing faecal contamination and disinfecting can create an infectious aerosol and contribute to spread of disease within calf accommodation (Wray, 1993). Even after intensive disinfection procedures have been followed, salmonellae can survive for several months in some premises (Twiddy *et al.*, 1988). Individual penning of calves has not been shown to prevent excretion compared to group penning, as non-contagious routes of transmission are equally important (Wray, 1993). Large calf houses are best subdivided to reduce the common airspace susceptible to aerosolisation (Wathes *et al.*, 1988). Where serious problems occur, removing calves either to temporary accommodation, or out to grass with shelter will be necessary.

Isolation

Dedicated isolation facilities are associated with reduced risk of salmonella spread (Evans and Davies, 1996). Regular cleaning out of calving accommodation also prevents neonatal infection (Anon, 1992), particularly if used to house an aborted cow.

Treatment for fluke infection

There may be increased risk of carriers and salmonellosis in herds with fluke infection (Aitken *et al.*, 1979), though this relationship has been challenged (Morisse and Cotte, 1994; Taylor and Kilpatrick, 1975). Treatment during the dry period, is advisable in high-risk herds. As fluke infection is often subclinical or non-clinical, it is worth regularly checking for liver lesions in cull cows at the abattoir. With wet summers infection levels may be high.

Control of concurrent infections

It has been suggested that salmonella infections are more severe in herds with underlying temporary immunosuppression caused by bovine virus diarrhoea or respiratory virus infections (Penny *et al.*, 1996, Wray and Roeder, 1987), though this relationship has been challenged (Morisse and Cotte, 1994). Control of the concurrent infections may reduce the severity of salmonella infection. [Control of BVDV infection is dealt with in the paper by Sexton]. As no information is available on the concurrent use of Bovivac S with other vaccines, no other vaccine should be administered within two weeks before or after Bovivac S use. It should also be noted that use of a common rectal thermometer, without disinfection, could spread salmonella between cases (McAllister *et al.*, 1986).

Colostrum feeding

Passive protection from colostrum can play a critical role in reducing excretion and the risk of clinical disease. Assisted suckling or artificial colostrum feeding after calving and prolonged feeding of vaccinates colostrum for at least two weeks will reduce risk of excretion.

Immunostimulation

There may be a practical benefit in supplementing at-risk animals with vitamin E and selenium to improve their immunity (Davies and Renton, 1992; Finch *et al.*, 1986; Cawley *et al.*, 1986). Enhanced production of antibodies to *S. typhimurium* has been found in cattle following vitamin E and selenium supplementation (Nemec *et al.*, 1990). Patented immunostimulants are claimed to establish protection more rapidly with salmonella vaccines (Immvac Inc.,).

Vaccination

Currently, there is only one salmonella vaccine licensed in the Republic of Ireland; Bovivac S (Intervet Ireland Ltd.). This compares with more than ten salmonella vaccines in the USA. Bovivac S (which contains both *S. dublin* and *typhimurium* antigens), is licensed (September, 2001) for the active immunisation of cattle in order to induce serological and colostral antibody production and in the face of an outbreak to reduce *S. typhimurium* infections as part of an overall management programme. The licence does not specify prevention of either salmonella abortions, or diarrhoea in adults or calves where no prior evidence of infection exists. It may not provide cross-protection against exotic strains of salmonella. However, it is widely used on dairy farms to prevent these problems, especially salmonella abortions. Empirically, vaccination has been used for some 30 years in the control of salmonella abortion (Cotgreave and Cameron, 1974) and many veterinary practitioners believe it is efficacious. A recent questionnaire survey of dairy farmers in discussion groups showed 42% of farmers vaccinated their cattle against salmonellosis (Table 2).

Table 2: Use of vaccines in dairy herds in Munster and Leinster (1999-2000)

Disease	No. of herds	% of herds vaccinated
Leptospirosis	208	78
Salmonellosis	207	42
BVD	110	6

No economic assessment has been conducted on the cost-effectiveness of annual re-vaccination whether following a salmonella outbreak or in the absence of a confirmed problem. Specific experimental data have not been generated to quantify the duration of immunity or the effectiveness of a single booster dose of Bovivac S. As the disease may be self-limiting, the efficacy of vaccination following some outbreaks may be overestimated (Mee, 1990). Outbreaks of salmonellosis on a calf-rearing, dairy or beef unit, with abortions and mortalities have run to estimated losses of between £5,000 and £20,000 (Peters, 1985; Mee and Malone, 1995; Davies and Renton, 1992). Circumstantial evidence in 1999/2000, when supplies of vaccine were unavailable and salmonella outbreaks increased, indicates vaccination may be preventing clinical cases and, hence, economic losses. Vaccination may be more relevant following outbreaks of *S. dublin* than following *S. typhimurium* as in the latter case the disease can be self limiting while in the former infection can persist for years. Vaccination has been shown to significantly reduce *S. typhimurium* excretion in problem herds (Davies, 1997). Premature discontinuation of vaccination (<2 years) following a salmonella outbreak has been associated with new or recurrent infections (Davies, 1997). A recent review of bovine salmonella vaccines in the USA concluded that such products provide partial protection varying between good and ineffective against salmonella challenge (House and Smith, 1997). Lack of controlled split-herd vaccination studies limits interpretation of the effectiveness of current vaccination regimes.

With increased animal health problems in dairy herds and vaccines available for cows against leptospirosis, salmonellosis, BVDV, rotavirus, coronavirus and *Escherichia coli*, some farmers are questioning the need to use some or all of these products in order to reduce costs. The unique risk factors on each farm must be recognised when making this decision. Whether vaccination should be carried out and for how long is a decision to be made following consultation with your veterinary practitioner and local veterinary laboratory, as necessary. When faced with potential animal and financial losses from salmonellosis, the precautionary principle is generally adopted. At current vaccine costs, prevention of only one or two salmonella abortions or mortalities annually would be sufficient to cover the costs of vaccination (Wright and Fernando, 1993). This assumes abortions or mortalities would continue to occur in the absence of vaccination and not following vaccination. However, there may be farmers using vaccine where an economic response would not be predicted from the farm risk profile and disease history. In economic terms, vaccination is justified where E_i > VC/(DC x VE). E_i is expected incidence of disease, VC is vaccination cost, DC is disease case cost and VE is vaccine efficacy. Enterprises with a high risk such as calf rearers or large, open dairy herds, with active BVD or fluke infection, possibly close to landfill dumps, or herds with a recent history of salmonellosis may benefit more than lower risk enterprises.

Q. *What are the risks of human infection from salmonella on the farm?*

In considering whether to adopt a control policy against salmonella, the risk of human infection should be considered. The primary risk is with *S. typhimurium*. In a UK study, 20 % of farms affected with *S. typhimurium* DT104 had possible or confirmed associated human illness in farm workers or family (Evans and Davies, 1996). Children who participate in calf feeding and handling are particularly at risk (Wall, *et al.*, 1995). Personal hygiene should be emphasised. Infection may be contracted via direct or indirect contact or consumption of unpasteurised milk. It should be recognised that the incidence of salmonella in randomly selected bulk tank raw milk in the Republic of Ireland is extremely low (<0.20 %) (Rea, *et al.*, 1992). Cows with *S. dublin* infection may be prone to more assisted calvings (Richardson, 1973) which presents the risk of dermatitis to farmers or veterinarians handling infected cows. Salmonella may also be transmitted via mouth-to-mouth resuscitation; hence this practise is not advisable for weak calves (Ahmad, *et al.*, 1990).

Conclusions.

Salmonellosis can be a devastating disease causing severe financial loss in certain high-risk herds. Current control methods are a mixture of proven and empirical measures. Knowledge gaps in the disease epidemiology and efficacy of preventive measures under Irish farming conditions frustrate attempts to develop clearer control policies. Towards this end, Teagasc Moorepark has initiated a research programme on salmonella epidemiology in conjunction with the Cork Regional Veterinary Laboratory, Cork County Council and local hospitals (Crilly, 2000b).

References

Ahmad, F., Senadhira, D.C.A., Charters, J. and Acquilla, S. (1990) Transmission of salmonella via mouth-to-mouth resuscitation. *Lancet* **335** 787-788.

Aitken, M.A. (1987) Causes and control of Salmonella infections in dairy cattle. *Irish Grassland Association Journal.* **21** 123-127.

Aitken, M.M., Hughes, D.L., Jones, P.W., Hall, G.A. and Smith, G.S. (1979) Immunological responses of fluke-infected and fluke-free cattle to *Salmonella dublin* and other antigens. *Research in Veterinary Science.* **27** 306-312.

Anon. (1992) Salmonellosis affects cattle of all ages. *Veterinary Record.* p.101.

Anon. (1999) Quarterly report of the Regional Veterinary Laboratories. *Irish Veterinary Jourrnal.* **2** pp264.

Anon. (2000) Quarterly report of the Regional Veterinary Laboratories. *Irish Veterinary Journal.* **53** pp196.

Cawley, G.D., McPhee, I., Lucas, B. and Hall, T. (1986) The effects of maternal selenium therapy on calf survival. *Proceedings of the Association of Veterinary Teachers and Research Workers* p.2

Choo, P.Y. (1989) Observations on *Salmonella dublin* abortions in cattle. *J. Vet Malaysia.* **1** 35-39.

Cotgreave, D.H. and Cameron, I.R.D. (1974) Salmonellosis. *Veterinary Record.* **95** 401-402.

Crilly, J. (2000a) Salmonella has killed up to 50% of affected herds. *Irish Farmers Journal* w/e April **15** 4-5.

Crilly, J. (2000b) The epidemiology of salmonellosis in Cork and Kerry. *Moorepark Production Research Centre, ARMIS proposals,* p.8.

Davies, R. (2001) *Salmonella typhimurium* DT104: Has it had its day? *In Practice* **23** 342-350.

Davies, T.G. and Renton, C.P. (1992) Some aspects of the epidemiology and control of *Salmonella typhimurium* infection in outwintered suckler cows. *Veterinary Record* **131** 528-531.

Davies, R.H. (1997) A two year study of *Salmonella typhimurium* DT 104 infection and contamination on cattle farms. *Cattle Practice.* **5** 189-194.

Eld, K., Gunnarsson, A., Holmberg, T., Hurvell, B. and Wierup, M. (1991) Salmonella isolated from animals and feedstuffs in Sweden during 1983-1987. *Acta Vet. Scand* **32** 261-277.

Euden, P.R. (1990) Salmonella isolates from wild animals in Cornwall. *British Veterinary Journal* **146** 228-232.

Evans, S.J. and Davies, R.H. (1996) Case control study of multiple resistant *Salmonella typhimurium* DT104 infection in cattle in Great Britain. *Veterinary Record* **139** 557-558.

Finch, J.M., Lucas, B., Cawley, G.D. and Turner, R.J. (1086) Immune response to *Salmonella dublin* in sheep and cattle: the effect of supplementary selenium. *Proceedings of the 6th International Conference on Production Diseases in Farm Animals,* Belfast. 199-201.

Giles, N. and King, S.C. (1987) Excretion of *S typhimurium* from a cow's udder. *Veterinary Record* 120: 23.

Greene, H.J. and Dempsey, D. (1986) Bovine neonatal salmonellosis: an outbreak in a dairy calf rearing unit. *Irish Veterinary Journal* **40** 30-34.

Hatch, J. (1974) Salmonellosis outbreak. *Veterinary Record* **95** 425.

Hinton, M. (1974) *Salmonella dublin* abortion in cattle: studies on the clinical aspects of the condition. *British Veterinary Journal* **130** 556-562.

Hoorfar, J. and Bitsch, V. (1995) Evaluation of an O-antigen ELISA for screening cattle herds for *Salmonella typhimurium. Veterinary Record* **137** 374-379.

House, J.K. and Smith, B.P. (1997) Evaluation of bovine salmonella vaccines. *Proceedings of the United States Animal Health Association.* www.usaha.org.

Humphrey, T.J. and Bygrave, A. (1988) Abortion in a cow associated with salmonella infection in badgers. *Veterinary Record* **123** 160

Hunter, A.G. and Peek, I.S. (1977) Vaccination control of an outbreak of *Salmonella typhimurium* infection in suckler cows and calves. *British Veterinary Journal* **133** 239-244.

Johnston, W.S., MacLachlan, G.K. and Hopkins, G.F. (1979) The possible involvement of seagulls (*larus* spp.) in the transmission of salmonella in dairy cattle. *Veterinary Record* **105** 526-527.

McAllister, T.A., Roud, J.A., Marshall, A., Holland, B.M., and Turner, T. L. (1986) Outbreak of *Salmonella eimsbuettel* in newborn infants spread by rectal thermometers. *Lancet* May, 1262-1264.

McIlroy, S.G., Neill, S.D., Goodall, E.A., McLoughlin, E.M., and McCracken, R.M. (1990) Salmonella isolates from humans and production animal species in Northern Ireland from 1979-

1988. *Proceedings of the Society of Veterinary Epidemiology and Preventive Medicine*, Belfast. 24-48.

Mee, J. F. (1990) Control of salmonellosis. *Irish Farmers' Journal*, w/e April 28th p. 26.

Mee, J. F. (1995) Terminal gangrene and ostitis in calves attributed to *Salmonella dublin* infection. *Irish Veterinary Journal* **48** 22-28.

Mee, J. F. and Malone A. (1995) An outbreak of *Salmonella dublin* abortion in outwintered dairy cows. *Irish Veterinary Journal* **48** 314-315.

Meleady, E., Yearlsey, D., O' Brien, D., and Egan, J. (2000) Serum antibodies to *Neospora caninum*, *Leptospira hardjo* and *Salmonella dublin* in cows in the Republic of Ireland. *Irish Veterinary Journal* **53** 266.

Morisse, J.P. and Cotte, J.P. (1994) Evaluation of some risk factors in bovine salmonellosis. *Veterinary Research* **25** 185-191.

Nemec, M., Hidiroglou, M., Nielsen, K., and Proulx, J. (1990) Effect of vitamin E and selenium supplementation on some immune parameters following vaccination against brucellosis in cattle. *Journal of Animal Science* **68** 4803-4309.

O' Reilly, P.J., and Egan, J. (1988) Leptospiral and salmonella abortions and stillbirths in cattle – a survey. *Irish Grassland and Animal Production Association Journal* **22** 155

Penny, C.D., Low, J.C., Nettleton, P.F., Scott, P.R., Sargison, N.D., Strachen, W.D. and Honeyman, P.C. (1996) Concurrent bovine viral diarrhoea virus and *Salmonella typhimurium* DT104 infection in a group of pregnant dairy heifers. *Veterinary Record*. **138** 485-489.

Peters, A.R. (1985) An estimation of the economic impact of an outbreak of *Salmonella dublin* in a calf rearing unit. *Veterinary Record* **117** 667-668.

Plym-Forshell, L. and Ekesbo, I. (1996) Survival of salmonellas in urine and dry faeces from cattle – an experimental study. *Acta Vet Scand* **37** 127-131.

Power, E.P., and O' Keeffe, F. (1991) Osteomyelitis of the cervical vertebrae of a calf due to *Salmonella dublin*. *Irish Veterinary News* **13** 31-33.

Rea, M.C., Cogan, T.M. and Tobin, S. (1992) Incidence of pathogenic bacteria in raw milk in Ireland. *Journal of Applied Bacteriology* **73** 331-336.

Richardson, A. (1973) Obstetrical difficulty in *Salmonella dublin* carrier cows. *Veterinary Record* **92** 151.

Robinson, M. (1997) A practitioners approach to a farm incident of salmonellosis. *Cattle Practice* **5** 185-188.

Selim, S.A., Cullor, J.S., Smith, B.P., Blanchard, P., Farver, T.B., Hoffman, R., Dilling, G., Roden, L.D., and Wilgenburg, B. (1995) The effect of *Escherichia coli* J5 and modified live *Salmonella dublin* vaccines in artificially reared neonatal calves. *Vaccine* **13** 381-90.

Smith, B.P., and House, J. (1992) Prospects for salmonella control in cattle. *Proceedings of the 17th Buiatrics Congress*, St Paul, Minnesota **1** 67-73.

Spier, S.J., Smith, B.P., Tyler, J.W., Cullor, J.S., Dilling, G.W., and Pfaff, L.D. (1990) Use of ELISA for detection of immunoglobulins G and M that recognize *Salmonella dublin* lipopolysaccharide for prediction of carrier status in cattle. *American Journal of Veterinary Research* **51** 1990-1904.

Taylor, S.M. and Kilpatrick, D. (1975) The relationship between concurrent liver fluke infection and salmonellosis in cattle. *Veterinary Record* **95** 342-343.

Twiddy, N., Hopper, D.W., Wray, C. and McLaren, I. (1988) Persistence of *S. typhimurium* in calf rearing premises. *Veterinary Record* **122** 399.

Tyler, J.W., Hancock, D.D., Wilson, L., Muller, F., Kryteberg, D., and Bradish, S. (1999) Effect of passive transfer status and vaccination with *Escherichia coli* (J5) on mortality in comingled dairy calves. *Journal Veterinary Internal Medicine* **13** 36-69.

Van Duijkeren, E., Flemming, C., Van Oldruitenborgh-Oosterbaan, M.S., Kalsbeek, H.C., and

Van der Giessen, J.W.B. (1995) Diagnosing salmonellosis in horses; culturing of multiple versus single faecal samples. *Veterinary Quarterly* **17** 63-66.

Wall, P.G., Morgan, D., Lamden, K., Griffin, M., Threlfall, E.J., Ward, L.R. and Rowe, B. (1995) Transmission of multi-resistant strains of *Salmonella typhimurium* from cattle to man. *Veterinary Record* **136** 591-592.

Warnick, L.D., Crofton, L.M., Hawkins, M.J., Pelzer, K.D., Ruth, R.A., and Scheel, K.R. (1995) Case-control study of clinical salmonellosis in cattle herds. *Proceedings of the 76th Annual Meeting Conference of Research Workers in Animal Diseases,* Chicago, Abst. no.102.

Wathes, C.C., Zaidan, W.A.R., Pearson, G.R., Hinton, M., and Todd, N. (1988) Aerosol infection of calves and mice with *Salmonella typhimurium*. *Veterinary Record* **123** 590-594.

Wray, C. (1993) Bovine salmonellosis: An update. *Irish Veterinary Journal* **46** 137-140.

Wray, C., Wadsworth, Q.C., Richards, D.W., and Morgan, J.H. (1989) A three-year study of *Salmonella dublin* infection in a closed dairy herd. *Veterinary Record* **124** 532-535.

Wray,C. and Roeder, P.L. (1987) Effect of bovine virus diarrhoea – mucosal disease virus infection on salmonella infection in calves. *Research in Veterinary Science* **42** 213-218.

Wright, E. J. and Fernando, R.J. (1993) An investigation into the economic effect of abortion in dairy cattle. *Veterinary Annual* **33** 84-97.

B.V.D.

MICHAEL F SEXTON, M.V.B.,
Riverview Veterinary Clinic, Bandon, Co. Cork.

Definition

Bovine Viral Diarrhoea (BVD) is a cattle virus. This is a misnomer since the name masks the true range of symptoms which it can elicit. It is believed to be in Ireland for the last 50 years. BVD is very similar to classical swine fever in pigs and border disease in sheep. In humans, it is not unlike Rubella (measles) though it is important to note that it does not cause any symptoms or disease.

Contagious spread

BVD virus only survives for short periods of time outside its host animal (cattle) and is therefore dependent on them for its transmission. Cattle typically carry the virus for about three weeks after initial infection. In this period of time they may spread the virus to those it comes in contact with (transient carriers). Some animals carry the virus for life. These are called persistently infected carriers (P.I.) and they are much more effective in spreading the disease. To a lesser extent, other ruminants (sheep) and humans can also transmit the virus to cattle.

Transmission

There are two main ways of spread within a herd:

Horizontal Spread

This occurs where a carrier (transient or persistent) passes the virus onto another animal.

Vertical Spread

Vertical transmission is from dam to offspring and only occurs in the womb.

SYMPTOMS

These can vary quite a lot and depend on the transmission type and the stage of pregnancy. In the case of vertical transmission, the virus has the ability to cross the womb wall into the placenta where it has easy access to the developing embryo. If this occurs in the first half of pregnancy, then one may find a lot of repeat breeders due to early embryonic death. If the embryo is at the three to four month stage of development, then the embryo may well survive infection and a persistently infected animal (P.I.) will be born.

If infection takes place later on in pregnancy, abortion is a likely outcome. Sometimes abortion may not occur and those that survive it may be born with defects, mainly of a skeletal or neurological order.

Horizontal spread causes few problems especially in non-breeding adult stock. However it can be a problem if it enters a young calf population. There is some evidence to show that it affects the immune systems of calves, thus leaving them susceptible to pneumonias, scours and other infections.

TREATMENT

There is no treatment for B.V.D. infection. Symptoms may be treated but the virus may not. Therefore the only control is prevention.

CONTROL

Eradication

Some form of eradication should be attempted as part of a control programme. This is based around the detection and elimination of persistent carriers (P.I.). This is done by checking animals to see whether or not they are carrying the virus. Depending on the severity of the problem in the herd, this can be a full herd screen (where all breeding stock are checked), partial screen (replacement heifers checked every year) or a "bought-in" screen (where all bought-in breeding stock are examined). Maintaining a closed herd status is vital where any of the above is being attempted.

Vaccination

The aim of vaccination should be to reduce the deleterious impact of B.V.D. infection on the overall herd health. If fertility problems are the most obvious symptom in the herd, then pre-breeding vaccination is essential. This will also help eliminate vertical spread and so also reduce the creation of P.I. animals. Alternatively, if neonatal calf problems are the major manifestation, then pre-calving vaccination to booster the colostral antibodies may be the most opportune time.

I.B.R. (Infectious Bovine Rhinotracheitis)

Similar to B.V.D., this is a cattle viral infection which can cross the placenta and cause abortions. There are two distinct syndromes here:

Calf Pneumonia Complex.

Adult infections.

Calf penumonia complex

Viral pneumonia in calves is an annual problem, be it, in neonates in late spring, or weaners in the autumn. The pathogenesis is quite similar with in many cases a combination of viruses infecting susceptible animals. One of the most common of these viruses is I.B.R. It is difficult to treat, but can be controlled by vaccination where it is diagnosed.

Early neonatal pneumonia

This usually occurs in young bucket fed calves in housed conditions. As late March early April approaches, numbers increase, temperatures rise and housing gets stuffy. In this environment, I.B.R. flourishes. This problem can be treated with an array of antibiotics. However, where I.B.R. is identified, vaccination should also be considered. Where possible, the intra nasal route should be used since this can be given to very young calves before any lung damage occurs and can elicit a prompt antibody response.

Weaner pneumonia

Typically this can occur in late September to early December depending on weather conditions, weaning and or transporation and movement. Prevention here is easier to apply since the time of weaning and transport is calendar based and therefore vaccination can be given at an appropriate interval beforehand.

Adult infections

I.B.R. is an alpha Herpesvirus. These viruses do not survive too long outside the host animal. However when they infect an animal, the virus remains there for life. The host produces antibodies to the virus and after time they both (antibody and virus) balance one another out. At this stage, these animals no longer shed the virus and therefore they appear as normal. However, the virus can be reactivated at times of stress, calving, hoose infestation and thus the animal may start shedding it and passing the infection onto others.

Abortion

This is one of the most common symptoms. Diagnosis is best made by getting part of the placenta and caruncle (button) tested for the infection. Blood samples may also be useful in checking for antibodies.

Febrile Cow

Sometimes cows can present with very elevated temps, 106F, no milk, very dull and depressed and sometimes diarrhoea. It is quite common to get more than one cow affected at any one time. Serological samples or nasal swabs can confirm the diagnosis here. However it is important to note that there are many more conditions that can cause the above symptoms.

Vaccination (in adults)

Vaccination of adult cattle against I.B.R. is not very common. However, where either of the above problems exists it should be considered. Most commercial vaccines can be given either intranasally or intramuscularly. Obviously, in adult cattle, the latter might be more practical.

Neospora caninum abortion in cattle

DONAL TOOLAN
Regional Veterinary Laboratory, Hebron Road, Leggatsrath, Kilkenny

Introduction

Neospora caninum (N. caninum) abortion has recently been recognised worldwide as an economically important cause of bovine abortion. In 1990, workers in California reported that Neospora caninum was associated with 18% of bovine foetuses submitted for routine examination as to the cause of abortion. However, in a study involving 20,000 cattle, where every abortion was investigated, they concluded that *N. caninum* was responsible for 43% of abortions.

Cause

N. caninum is a protozoan parasite that closely resembles *Toxoplasma gondii (T.gondii)*, a common cause of abortion in sheep. The details of the life cycle are still being investigated but the following is known:

The dog is a definitive host and is the principal source of infection for cattle. An infected dog passes infective oocysts in its faeces. If a cow ingests these oocysts, it becomes infected persistently. This can lead to abortion, or a full term calf born with nervous signs (unable to stand or walk properly) or to the birth of a full term, clinically normal calf that develops normally but remains persistently infected and may abort in future.

There is an important difference between *T. gondii* infection in sheep and *N. caninum* infection in cattle. Sheep infected with toxoplasmosis normally abort only once from this cause so it is worthwhile retaining them in the flock. On the other hand, a cow infected with *N. caninum* may abort repeatedly.

Prevalence

N. caninum was initially reported from California but has now been confirmed worldwide. Surveys in Britain, Northern Ireland and in Kilkenny showed that the incidence in these areas was similar to each other but not as high as in California. It was estimated that 6 – 8 % of foetal brains in this part of the world showed evidence of foetal infection. The comparable figure for California was 18%.

Clinical signs

In some herds only one or two abortions due to *N. caninum* occur whereas in other heavily infected herds, the abortion rate may reach 20-30%. An animal infected with *N. caninum* may abort repeatedly or may abort one year, have an apparently normal calf the following year and abort again the year after that. The first time a herd becomes heavily infected with *N. caninum*, abortions may occur as a storm, with a quarter or a third of the herd aborting over a couple of weeks. Abortions due to Neospora may occur at any stage of gestation. There is often a peak at 5 to 6 months gestation. In Kilkenny, a lesser peak at 8 to 9 months has been observed. A foetus aborted due to *N. caninum* does not show any characteristic change on visual examination. Neither are there any gross alterations in the afterbirth.

Diagnosis

Diagnosis of neosporosis is made by laboratory tests and clinical history. *N. caninum* may occur in conjunction with other causes of abortion so it is important to investigate abortions thoroughly for all diagnosable causes of abortion. This involves the submission of the foetus, placenta and a blood sample from the dam. In Kilkenny laboratory, the blood of all foetuses is screened for *N. caninum* antibodies. The brain may be examined microscopically in selected cases. Blood samples from cows that have aborted are screened routinely for *Salmonella dublin* and for *Leptospira hardjo* and are tested for *N. caninum* if requested.

Prevalence in South-East Ireland

A survey of the local prevalence of *N. caninum* was made, based on the material submitted to Kilkenny Regional Veterinary Laboratory for the diagnosis of bovine abortion in the twelve months July 99 to June 00. Serological evidence of *N. caninum* infection was found in 7% of foetuses and in 14% of cows that had aborted recently. These figures show that exposure to *N. caninum* is widespread. An alternative diagnosis of the cause of abortion was found in almost half of these animals, so the percentage of abortions primarily due to *N. caninum* is lower. An animal positive for *N. caninum* was identified in 48 herds. Sixteen of the farmers involved replied to a questionnaire. Roughly two thirds (63%) of those who responded had a low abortion rate in their herds, just one or two abortions in the year. A possible alternative cause of abortion was found in 40% of these (one case of salmonellosis and three of leptospirosis). Therefore, the diagnosis of *N. caninum* abortion in a herd does not necessarily imply that there will be widespread losses.

The remaining six farmers that replied to the questionnaire reported an abortion rate of 10 – 21%. A possible alternative diagnosis was found in two thirds of these herds (one of salmonellosis and three of leptospirosis). However, in two herds, with abortion rates of 21% and 15% respectively, no other cause of abortion was found and there was widespread evidence of *Neospora*. One of these herds had had severe losses the previous year from *Neospora*.

Case studies of herds with severe Neospora problem:

Herd A:

Dairy herd, with 80 cows and 15 heifers. Over the previous three years, there had been 17, 10 and 20 abortions. At least 6 cows aborted more than once.

Herd B:

Dairy herd with 75 cows. 12 cows aborted in one week.

Risk to human health

N. caninum differs from *T. gondii* in that there is no evidence of it being harmful to humans.

Vaccination

There is a lot of research being conducted at the moment into immunity against *N. caninum*, but at present, there is no proven commercially available vaccine available. However, as cows aborting from neosporosis can abort again from the same cause, it is not clear that it will be possible to make an effective vaccine. Although *N. caninum* resembles *T. gondii* in appearance there is very limited cross reaction between the two parasites and therefore a vaccine against toxoplasmosis will not protect against neosporosis.

Control

The life cycle and methods of infection of cows with *N. caninum* are not sufficiently well understood to give confident advice on the control of neosporosis. While awaiting a fuller understanding, the following suggestions can be made:

It is good practice to isolate any animal that looks about to abort and to keep it away from the rest of the herd until it has cleansed and ceased to discharge. However, it has not been shown that a cow aborting from *N. caninum* can transmit the infection to other cattle.

Dogs should not be allowed to contaminate food or water. It is easy enough to avoid access to the concentrate feed but dogs must also be prevented from defaecating on pasture. (Will farm dogs in future be kept in runs and will the farmer let them out twice a day and follow them with a plastic bag and pick up after them??). Stray dogs and dogs of hunters should be kept off the land. Foxes have not yet been shown to be definitive hosts but it is possible that they also are involved. Dogs should be kept away from calving pens and not allowed access to foetuses or placentae.

As neosporosis is often associated with infection by *Salmonella* spp.or by *Leptospira* spp., vaccination against these organisms may help to reduce losses.

If the prevalence of *N. caninum* positive animals is low, culling of such animals may be practicable.

If the incidence of neosporosis is high and causes high losses each year, blood testing the whole herd might be advisable. Blood tests are often positive only around the time of abortion and in late pregnancy and become negative at other times, so it is possible for infected animals to be missed by the blood test. Repeat blood tests may be necessary to identify all infected animals. Once the infected animals are known, neosporosis can be considered as another criterion in deciding on which animals to cull each year. As the culled infected animals are replaced by purchased or homebred non-infected animals, both categories of animal should be separated at the time of calving or abortion.

There is no reliable way of showing that a dog is free from *N. caninum* infection. The infective stage of the parasite is shed for only a few days and is therefore most unlikely to be discovered by laboratory examination. By the time the abortions start, the dog will have probably ceased to shed the parasite.

Conclusion

Exposure to Neospora is common among cows in Ireland. In many herds, the infection rate is low and economic losses are slight. In occasional herds, the infection rate is high and a sudden catastrophic abortion storm can occur with a quarter or a third of all cows aborting over a couple of weeks and similar heavy abortion losses being repeated in subsequent years. There is a lot of research going on worldwide into this problem at present and currently there is a major project underway at Abbotstown. Hopefully we will soon have better information on which to base practical advice on methods of control.

Sourcing and Training Labour for the Future

L. MYLES
Farm Apprenticeship Board

Summary

Falling numbers in farming, the drop in the number of children in farm families and competition from other sectors means that labour will continue to be a scarce resource in farming. Farmers therefore are in direct competition with other sectors of the economy for available labour. All potential sources of farm labour are examined.

In part the solution to the labour problem in farming will be determined by improved efficiencies in existing labour use rather than sourcing extra/new labour. This can be achieved by the adoption of efficient work methods and practices, better recruitment of farm staff, retention of staff and family labour through better treatment and staff training. Farmers/employers, along with training providers and others have a key role in promoting a career in agriculture to increase the entry level to the industry. The potential pool of labour on 'the doorstep' should also be exploited.

Farmers and the Industry as a whole can do more to increase the uptake of the wide range of training courses now on offer for entrants to farming. Improving the efficiency of existing staff through training is another option open to farmer employers.

Introduction

The availability and cost of farm labour is one of the biggest challenges facing progressive dairy farmers. The scarcity of labour in farming is well known. The demand for FAB graduates (has for many years) outstripped supply by 4 to 1. The Farm Relief Services constantly struggle to employ sufficient operators to meet demand. Farm employers will have to take on board proper recruitment and staff management techniques to compete for and retain employed labour in future.

The traditional/conventional sources of labour are as follows;

- Family Labour: owner, spouse, children, extended family.
- Local hired help: the son or daughter of a local family who "rambled in" at a young age and remained on to become a farm labourer/operative.
- Existing permanent staff:: employed from sources other than local help.
- Relief/part-time workers formally organised through Farm Relief Services.
- Casual help, students, foreign students.
- Training Schemes.
- Placement of students/trainees on farms.
- Graduates of training programmes.
- Contractor Services – particularly for silage, slurry etc.
- Others?

Trends in Labour Supply

A review of the available data for people working in farming clearly shows how the labour pool in farming has fallen.

Table 1. Number of person's (000) working in Agriculture (1995-1999)

	1995	1997	1999
*Holder	153.0	147.6	143.7
*Spouse	59.0	54.4	49.9
*Other family	66.0	66.0	63.4
Total family labour	277.9	268.0	257.0
Regular non-family workers	15.5	13.9	12.9
TOTAL	293.3	281.9	270.00

Source: C.S.O. Agricultural Labour Input data.

In the five year period 1995-99:

- The total number of people contributing some labour in agriculture fell by 9%.
- The number of farm holders has fallen by 6.1%.
- The total number of family members engaged in farming fell by 7.5% with a dramatic drop of 15.4% in the number of spouses contributing to the farm labour pool.
- The highest percentage drop at 16.8% took place among employed labour – regular non family workers.
- The biggest concern with regard to the falling labour pool in farming is that the greatest exit is taking place among the younger people (Table 2).

Table 2. Age profile of Irish farmers (% in brackets).

	1995	1999
Less than 35 years	20,900 (13.7%)	15,800 (11%)
45-54 years	34,500 (22.5%)	35,200 (24.5%)
Over 65 years	32,500 (21.2%)	33,000 (23%)
TOTAL	153,000	143,700

Source: C.S.O. Agricultural Labour Input Data.

Over half the fall in farm holders for the period 1995 – 1999 took place among the under 35 year olds. The decrease in the younger farm population has more significance for labour input in farming than the general fall in numbers of people engaged in farming. This trend has increased in recent years with C.S.O data showing the drop in farmer numbers being mostly accounted for by the fall in those under the age of 35 years.

Equally alarming is the dramatic downturn in the numbers of young people entering agricultural training courses over the past six years.

Table 3. Numbers enrolling in courses

Course	1994[1]	2000	% Decline
Agricultural College (1Year)	975	594	39%
Agricultural College – All courses			
1 year plus Diploma, Forestry etc.	1,147	788	31%
CIF/CRE Local Option	650	360	46%
FAB Programme≈	135	47	65%

[1]Peak year for enrolment in all courses.
[2]Impact of new Diploma Courses.

A recent ESRI study carried out for Teagasc by Kennedy and Williams estimated that farmers children in the 16-20 age chart will be 12,075 – a fall of 60% on 1996 levels (i.e. 5.5% reduction per annum). So the pool of farming children is going to drop even more.

It is worth noting that enrolment in Horticultural Courses has remained reasonably stable over the same period. Why is this? Is it that the Horticultural Sector can compete more favourable for labour? Is it more attractive? The sources of labour have not changed over time – the numbers and competition have! The jobs boom in the Tiger Economy has created competition for available labour. This is most clearly illustrated by;

a) the dramatic fall in farmers' spouses engaged in farming,

b) the serious decline in young people engaged in farming and,

c) the dramatic downturn in the numbers participating in agricultural training courses.

Solving the labour problem

So what can be done to slow down or reverse this trend? What can be done to get more out of the available labour?

Labour Efficiency

Due to technological developments, output per person engaged in farming has increased dramatically over time. However, much more can be achieved in this area in terms of farm facilities, work methods, labour and time organisation etc. Farmers need to be educated in this area to the potential improvements which exist on farms. Technology and labour efficiency can redress and correct the labour imbalance on many farms.

Recruitment

Traditionally farmers have been poor in this area. Job description, advertising and selection procedures need to be improved to compete with other job sectors.

Staff Training

Labour is one of the key factors of production. Yet little effort is made at training and developing staff employed in farming. Staff training receives huge attention in most other areas of employment. Most jobs are done poorly because of poor or no instruction in the first place. Training and instruction results in a good job being done quickly and safely, less mistakes, increased output, improved delegation, greater motivation and personal development. End result – better performance – higher profits.

Training Schemes

Heretofore training schemes which involve farm placement – particularly the Teagasc Certificate in Farming and the FAB Training programme – have been important providers of labour for the farmers involved. While the trend in participation levels in all courses is down there will be a significant increase in on-farm placements in all agricultural courses approved by the new National Qualifications Authority of Ireland (NQAI). From a farming perspective the following placements are planned;

Table 4. On-Farm Placements – Agricultural Courses

Course	Placement Duration
Vocational Cert. in Agriculture –'Level 2' (1 year Agricultural College, 2 years local option)	1 month
Vocational Cert. in Agriculture – 'Level 3'	9 months
Farm Management – (FAB)	2 years x 12 months
Diploma Courses (Dairy, Machinery, Arable Crops)	2 x 6 months
Teagasc/FAB Pig course	i2 years x 12 months
National Certificate in Agriculture	i3 months

(HETAC Course – CAO application)

Much more can be done to promote farming careers. The existing training agencies are well aware of this and steps are being taken to increase awareness and promotional activity among secondary school students. Farmers can play an important practical role in this. Farmer/employers can also do much more to improve the image of farming and provide better working conditions. The challenge to the industry is to sell careers and highlight the type of employment opportunities which exist in farming. We must also push to develop careers not just jobs and create opportunities for young people to move up the farming ladder.

Family Labour Pool

Traditionally the family provided the 'labour on the doorstep'. There is strong evidence now that children of farmers are turning away from farming. To some degree we have 'educated young people away from farming'. They are opting for a college life and non farming careers – many from large commercial farms. Some of the young people who do enter farming become frustrated with the lack of progress, poor involvement in the business, poor satisfaction and rewards. These are voting with their feet and leaving for off-farm jobs and other careers.

These problems/issues can be tackled. Part of the problem is the low involvement of family children in the farm work. Perhaps:

sons/daughters of farmers need to get their hands dirty again – at an early age?

- project a more positive image of farming and farming jobs.
- provide proper training and work experience for entrants.
- give responsibility where it is earned/deserved.
- involve in decision making and management at an early stage.
- provide satisfactory/attractive working environment.
- labour efficient facilities with a good balance between work and relaxation.
- further and continuous training – formal courses, Macra, discussions groups etc.
- social freedom for 16 to 22 year olds and older is essential to counter some of the attractions of city/town life.

'Surplus' family labour

The CSO data show that the majority of the farm labour force work less then one (1) annual work unit (1800 hours per annum) in farming. In 1999, 142,900 people contributed less than 1800 hours work in the year – 53% of the total people engaged in agriculture. 89,100 worked less than half of a work unit (900 hours) or one third (33%) of the total work force. It is well known that many of these people are engaged in off-farm employment and are doing so in increasing numbers. Nevertheless, I believe this identifies an important potential source of farm labour. It seems logical that a farmer with spare time would work at what he or she knows best – farming. New skills can be developed through training. These were and are still are an obvious pool of people for the Farm Relief Services. Why did relatively small numbers of these farmers (with spare capacity) participate or seek employment with FRS over the years? Was it the farming image? Job conditions (pay, hours, type of work)? Attractiveness of other jobs/careers?

Competition from other sectors again is a key factor. I feel the Farm Relief Services are on the right track by recruiting part-time farmers to deliver a service (such as fertiliser spreading) rather than pure 'labour'. With the right promotion, improved work environment on farms and better working conditions it should be possible to recruit more of these people on (commercial) farms that need labour. Look at contracting out the job not hiring staff.

Foreign Workers/Students.

Due to the continuing labour scarcity foreign workers have been sourced by agencies, Farm Relief Services and by individual farmers. The Farm Apprenticeship Board has become involved too – operating an Exchange Training Programme for students mainly from Eastern European Countries placing up to 25 students on farms. The data in Table

5 show the increasing number of immigrants being granted work permits in Ireland.

Table 5. The number of immigrants being granted work permits in Ireland

Year	Total Work Permits Granted	Work Permits Agriculture & Fisheries
1999	6244	449
2000	18000*	2963
2001 (to July 13)	18505	2794

*Subject to final clarification. Department of Enterprise and Employment

The data show that Ireland is now a country with strong immigration. Information on the type of work been taken up by immigrants in the agricultural sector is not available. However, evidence and experience on the ground suggests that most of these immigrants are working in the horticultural/mushroom/vegetables areas. Foreign workers from Latvia, Ukraine, Russia etc. have shown a keen willingness to work in repetitive like jobs and generally have a high work ethic. To date the students handled by FAB have been very successful at farm level. Language (with exceptions), is not a problem.

The Farm Relief Services places 250-300 foreign people on farms per year. While the number of farms with foreign workers is increasing they will not provide the sole solution to the labour problem. These workers too will have a tendency to follow better-paid jobs. The better employers will be more successful at attracting and retaining farm staff irrespective of where they are from. Nevertheless foreign workers have and will become an increasingly important source of farm labour. Training and language courses need to be provided for this group as they grow in importance. Obviously proper selection is critical to success. Proper handling (management) of the individuals by the farmer employers is equally crucial.

Short of labour?

Increasing the supply of labour is only part of the solution. The other is to reduce the labour required to operate and manage your farm business. The steps involved are summarised above at No.5 when discussing the *Family Labour Pool.*

Farmers need to stand back, take stock of their businesses and analyse where labour savings can be made. In many situations this can be achieved without any economic loss, in many cases economic advantages may accrue because more time is spent on management and high reward activities. Central to this approach is the use of contract labour and/or contract services. Off load work where you can. As stated earlier neighbouring farmers with ,time on their hands, could provide a useful service – especially at peak seasonal times (spreading fertiliser at calving, feeding, fencing, washing, slurry spreading, silage etc.). Look at options like contract rearing of calves, in calf heifers, off wintering dry stock etc. The cost of labour saved may make many of these options economically viable. A well run highly efficient contractor service should be used to the maximum.

SO WHICH IS THE MOST IMPORTANT SOURCE OF LABOUR? – SEE APPENDIX

Training in the Future

All courses in agriculture, horticulture and related areas will in future be accredited by the National Qualifications Authority of Ireland (NQAI). The NQAI has responsibility for guaranteeing the quality of education and training and promoting access, transfer and progression into and within education and training. The Authority will be putting in place policies to help students move between courses and colleges and developing a national framework of qualifications. Two councils will be established to carry out these functions for the NQAI. The further Education and Training Awards Council – FETAC – will have responsibility for what we generally call 'Vocational Training' at present and will absorb the functions of a number of providers in this area including Teagasc.

The Higher Education and Training Awards Council –HETAC – will be responsible for all higher education and training courses excluding Universities. HETAC incorporates the functions of the National Council for Education Awards (NCEA). For the first time some mainstream courses in agriculture and horticulture will come under the remit of Higher Education. Applications for HETAC courses will be made though the CAO system. The new format will also provide a 'Higher Education Links System',and will allow holders of FETAC (vocational) awards transfer to the Higher Education Courses under HETAC and allow holders of Awards at Certificate level in HETAC courses progress to higher levels – up to Diploma and Degree level. This is a very significant development in the area of vocational education and training in agriculture. It removes what many saw as a barrier to recruitment into agricultural training and education courses. It is hoped that this will help recruit extra people into courses leading to careers in agriculture. This new format will commence in September 2001.

What will this mean for the education and training of people in and for agriculture, horticulture, etc.? For simplicity I will confine my remarks to training and education in agriculture (farming) – the area of most interest to this association. The Certificate in Farming or Green Cert. programme is now replaced by the National Vocational Certificate in Agriculture. This will be available in two phases and be operated by Teagasc under FETAC;

Phase 1 – a one year course conducted full time at an Agricultural College or a two year course if conducted part time at a local Teagasc Centre.

This phase will include four weeks on farm placement and 'specialisation' will be possible. Successful participants will be awarded a National Vocational Certificate in Agriculture Level 2 (subject to confirmation).

Phase 3 – Entry will be confined to holders of a "Level 2 Certificate". It will consist of a further year's training consisting of 36 weeks on farm placement and up to 8 weeks course work. A National Vocational Certificate in Agriculture Level 3 (subject to confirmation) will be awarded to successful participants.

Variations of the above will exist for those returning to farm part time in the future and for Horticulture, Forestry, Horses.

New CAO Listed Course

Teagasc has established and got HETAC approval/accreditation for a new course listed on the CAO System for the first time last January. This course will consist of two years of course work incorporating a mix of science and business with farm husbandry and management topics. It will include 12 weeks on farm placement in the second year. This course will be offered by a number of Agricultural Colleges in co-operation with adjacent Institutes of Technology. 225 CAO applicants listed the Agriculture Course as their first preference so it is possible that 70 – 80 young people will enrol in this course (in three centres) for 200/2001. The course will lead to a National Certificate in agriculture awarded by HETAC. It is expected that an application for a third year of course work leading to a National Diploma in Agriculture will be approved in the near future.

Further Training:

Further training or 'in-service' training for those engaged in farming is equally as important as young entrant training dealt within the previous section. Every business is dependent on the capabilities and skills of its workforce. Continuous updating of knowledge, skills and management and the acquisition of new skills (e.g. time management, grass budgeting, labour management) are essential to the continued success of your business.

How can farmers organise such in-service training for themselves and their staff?

Farmers have shown and continue to show that they can achieve a lot by working together and organising ways of achieving their goals. Discussion groups are an excellent example of this. They have become a highly significant element in adult training. This format can and should also be used for existing farm labour. In many areas of training what is required is organisation not facilities. That said farmers should look to using the facilities in our agricultural colleges – especially as there is spare capacity due to falling numbers. Colleges could play a major role in providing courses in the skills (milking, calving, calf rearing, grassland, office management etc.) and the business side of farming.

Farmers should, and I believe will pay for the cost of such in-service training. Training offers another way of improving labour efficiency and thus is an additional 'source' of labour.

Profiling the working year on Irish dairy farms – identification of some work areas towards improvement in efficiency

B. O'BRIEN[1], K. O'DONOVAN[1, 2], D. GLEESON[1], D.RUANE[2] and J. KINSELLA[2]
[1]Moorepark Research Centre
[2]University College Dublin

Introduction

Agricultural management and employment has undergone significant change in recent years. Total labour force decreased from 324,300 in 1992 to 269,900 in 1999; a decline of 16.7% or an annual decline of 2.4% (Frawley, 2000). In terms of the national labour force, agriculture accounted for 8 % in 1999, compared with 13% in 1992 - a drop of 5 %. The decline in farm workers (other family workers and non-family workers) was double that of farm holders between 1992 and 1999 (22.7% and 10.8%). To a large extent, the impact of labour shortage has successfully been overcome by increased productivity of the retained workforce. In New Zealand, economic pressures in the dairy sector influenced the need to develop ways of increasing productivity, e.g. increased number of cows to be milked per person per hour (Watkins, 2001). Nevertheless, the opportunity to further enhance labour productivity poses a strong challenge, given increasing costs and varying characteristics of the available labour.

Causative factors

The change in individual profiles within agriculture is a complex issue comprising a number of interrelated circumstances. The process of economic transformation and rapid development of the non- agricultural sector has had a significant influence. The direct involvement of women on dairy farms has decreased, as they are now retaining and/or seeking careers off-farm. A decline in the number of children returning to work on the home farm after leaving school has also placed pressure on labour requirements (Reid, 1997). In parallel with the increased demand for labour, there has been a decline in the number of people seeking farm work in the dairy sector. This is due in part to the low level of unemployment in recent years, enabling job seekers the opportunity to be more selective in the employment they accept. The current expectations of young people are for increased social activity, flexible time off, competitive wages and access to the attractions of urban centres. Today, dairy farming is seen by many as a less attractive career option than other forms of employment.

Outlook

The consensus is that there is unlikely to be any improvement in the supply of agricultural labour in the near future. In the context of future sustained growth in Irish agriculture, the role of farm labour will become increasingly critical.

Corrective action – general terms

Technological adjustment

Labour saving and augmenting strategies are necessary if Irish agriculture is to remain competitive. Such strategies should focus on finding alternative, and economically viable, labour saving and labour replacing devices. For some, improved labour efficiency and reduced stress will lie in the adoption of automated technology (e.g. installation of a high technology dairy). However, cost is often seen as a major obstacle together with concerns about the reliability of a complex, electronically operated system (Clarke, 1998). Mechanisation will not be a viable proposition until its potential benefits are proven to be greater than its cost. Also, mechanisation must be appropriate and readily adapted for use by a majority of farmers.

Structural adjustment

Structural adjustments including the use of contract labour may suit some farms, however this has a number of important implications. This type of labour is transient in nature, potentially making it an unreliable. Contract work arrangements may be successful, but much is dependent on the quality of the contract worker as well as other factors in the farm labour market.

Image

Farming in general needs to be seen as an attractive career opportunity for farm workers employed in family farm units, as well as in the largest corporate commercial farms. Dairy farming is often portrayed as having a negative image, which is not found in many non-agricultural business or career opportunities.

Corrective action – specific targets

Enhance research and development

The situation requires the development of processes that enable issues of research and development to be monitored and managed at an industry, regional and individual farm level. Ireland lacks data and research on human resource use on dairy farms. Farmers must critically examine and measure their labour use on the farm. What gets measured gets managed! Benchmarking is the process of comparing measures or indicators for the farm, with those of other farms having similar farming systems. This allows identification of best practices and areas for potential improvement necessary to achieve the best results (Leslie and Miller, 1999). The farmer may be able to improve labour use through revision of the current farming system, and/or by spending money on capital improvement on the farm.

Current research

The present shortage of available labour is unlikely to be reversed in the short term, and ultimately brings about a need to utilise what will be a smaller pool of labour more efficiently and effectively. To address this issue, a study on labour use on dairy farms has been put in place in the Dairy Production Research Centre at Moorepark. Part of this study is associated with a PhD degree programme of one of the authors, in conjunction with UCD, under a Walsh Fellowship. The database of labour use on dairy farms is still undergoing statistical analysis. Some of the initial findings from the study are presented in this paper.

Objective

To develop a blueprint for efficient labour use on commercial dairy farms, which has been tested and been shown to reduce the labour requirement, whilst being acceptable in terms of milk quality standards, the environment, animal welfare, and staff working conditions.

Study Framework

1. *Analysis of current labour use on dairy farms*

   Following a 12-month data collection process the labour requirement for the various farm tasks will be quantified. Areas of high labour demand will be identified, as will the farms on which they are most prevalent.
2. *Benchmarks*

   Benchmarks will be established based on the performance of the more efficient farms
3. *Planning and implementing change*

   Changes (proposed labour saving practices/investments, changes to farm and work routines) to the existing system will be introduced on a selected number of farms.
4. *Analysis and control*

   The effect of the changes will be measured and analysed in financial, physical and human terms
5. *Design of blueprints for 'best practice'*

   Changes identified as having a positive effect on the efficiency, sustainability or user friendliness of the system will be incorporated into labour-use blueprints. These blueprints will aim to reduce labour costs and allow for future expansion while complying with standards and other current regulations.

Design and methods

A population of 138 farms co-operated in the study, which commenced in February, 2000. These ranged in quota size from 30,000 to 310,000 gallons. Two sets of measurements were required: (l) The time taken to carry out the identified farm tasks and (2) a description of the farm infrastructure, i.e. the routines and procedures carried out on the farm together with facilities and layout on the farm and a profile of the farm personnel.

Time recording of tasks

A system was set in place whereby each of the farm tasks (total 28) would be defined and the amount of time devoted to each one was recorded.

Method 1. The Timesheet

The timesheet was designed as a user-friendly method of measuring the time consumed by the various farm tasks. The participant farms completed the sheets for a consecutive three-day period once per month. Completing the sheets involved recording the time consumed by each task on a daily basis. Therefore one sheet was distributed per farm covering all tasks and persons. Time off between the farm tasks was not recorded.

Method 2. ***The Psion Organiser***

The Psion Organiser is a hand held personal organiser, on which the operator recorded the time that each task consumed and the time of day that the task took place. The length of the farmer's day was visible, as was the proportion of time-off within the working day. The recording period on these farms was a five-day slot per month. An individual organiser was required for each labour person on the farm.

Questionnaires : Farm infrastructure

Questionnaires were completed by farmers on farm practices relating to feeding and cleaning associated with winter housing, calf rearing, the milking process (including parlour type and on farm fragmentation relating to blocks of land) and on Farm Profile.

Results to-date

<u>Net labour input for tasks</u>

The average net labour input per day over a 12-month period (68 farms for which data was available for all months) is shown in Figure 1. This represents the cumulative net labour input per day (may include more than one labour unit on a farm) for herds with an average quota of 91 K gallons and average herd size of 78. Net labour input on these farms peaked at 12.9 h in March and gradually declined to 8.3 h in December. This data represents the net labour input per day (excluding mealtimes, etc). Therefore the length of the total working day is substantially longer than this. When time associated with enterprises other than dairying was excluded, the average net labour input per day associated with dairying decreased from 11.5 h in March to 7 h in December. The time associated with enterprises other than dairying was increased for small quota holders, since that group operate other enterprises to a greater degree than large quota holders.

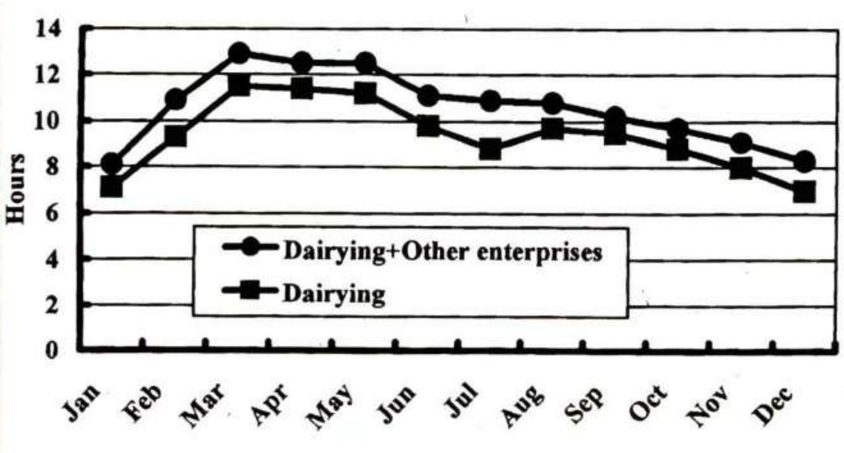
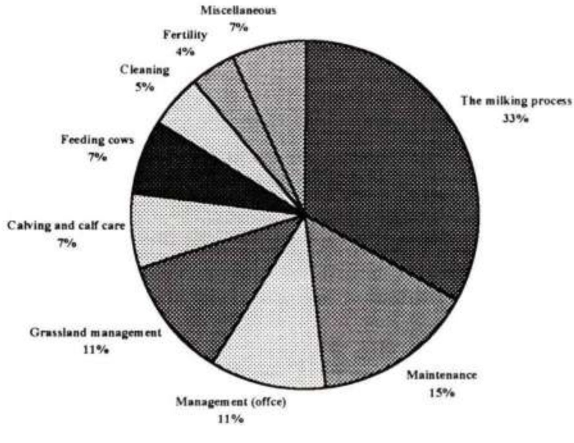


Figure 1. Average net labour input for tasks per day over 12 months

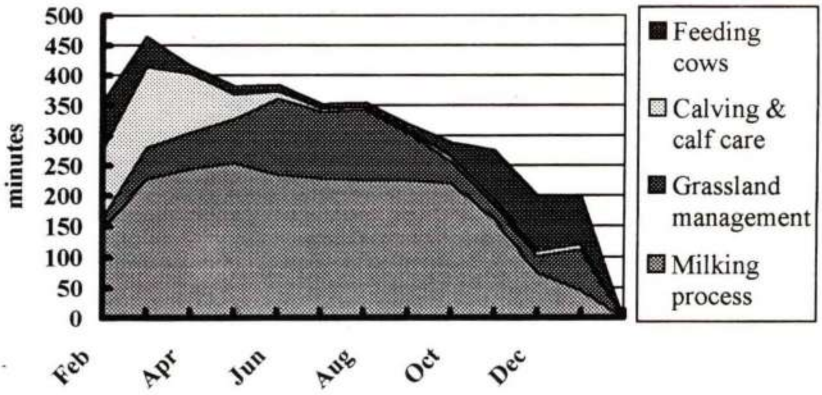
Over the 12 month period, net labour associated with tasks related to dairying comprised the milking process – 33 %, maintenance – 15 %, grassland management – 11 %, office – 11 %, calving and calf care – 7 %, feeding cows – 7 %, cleaning yards and houses – 5 %, fertility – 4 % and miscellaneous – 7 % (Figure 2). While net labour associated with many of these individual component tasks did not constitute a significant portion of total net labour (most tasks took less than 12 % of total net labour), they created labour peaks at various periods of the year (Figure 3). Time associated with the milking process was approximately 3.9 h per day, except during the winter period, when it was reduced to approximately 1.8 h per day. Time consumed by grassland management was at a maximum at 2.1, 1.8 and 2.0 h per day during June, July and August, respectively. The greater portion of time consumed by calving and calf care at an average of 1.9 h per day occurred during February, March and April. Time associated with feeding cows was at a maximum of 1.4 h between November and February. By targeting these four tasks (the milking process, grassland management, calving and calf care and cow feeding) for labour efficiency (reduced labour input), total net input of labour in each month over the 12 months (Figure 1) could be reduced, and the peak labour demand observed in March might also be reduced.

Figure 2. Breakdown of total net labour input associated with dairying over the 12



month period

Figure 3. Peak labour demand of the main tasks over the 12 month period



The milking process

Many dairy farmers spend several hours milking in systems designed to cope with herds of half the current size. Milking is generally seen as psychologically and physically stressful. The milking process has adopted a production line approach but often with only one person on the line, and that person is required to have expertise in several tasks. Since the milking process represents an average of 3.9 h of labour per day between March and November, it is appropriate to investigate existing obstacles or limitations to efficient milking and to suggest some modifications or changes, which would reduce this time.

Focus on the milking process and component tasks

The milking process (for the purpose of this paper) is defined as herding time (bringing cows from paddock to milking parlour and returning cows to paddock) plus milking time (clusters on/off) plus washing time (machine and yard) (Figure 4). The milking process was investigated for the month of June, since all cows of spring calving herds were milking at this time. In studying the milking process, spring-calved herds were categorised according to milk quota size (30 to 55 [29 herds], 55 to 70 [32 herds], 70 to 110 [28 herds] and 110 to 320 K gallons [25 herds]).

Time spent at the milking process as a proportion of the net labour input per day, for different quota categories, is shown in Table 1. The spring calved herds within the study, with quota ranging from 30 to 110 K gallons spent between 3.3 and 3.8 h at the milking process, which represented 32 to 34 % of the net labour input per day. Herds of quota category 110 to 320 K gallons spent 5.6 h at the milking process, representing 38 % of the net labour input per day.

Figure 4. Breakdown of the milking process time for the month of June

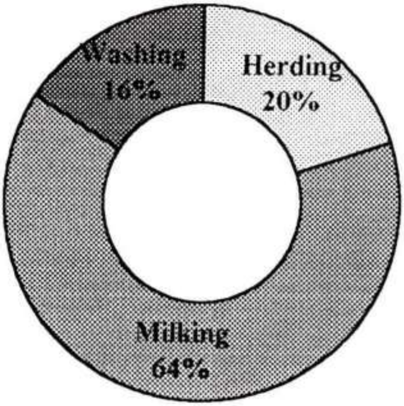


Table 1. Milking as a proportion of the net labour input per day, for different quota categories in the month of June (n=114)

Quota category (gals)	Net labour input per day (h)	Milking process (h)	%
30-55,000	10.0	3.4	34
55-70,000	10.2	3.3	32
70-110,000	11.4	3.8	33
110-320,000	14.9	5.6	38
Average	11.6	4.0	34

Time spent at herding, milking and washing, by spring calved herds in each of the quota categories, 30 to 55, 55 to 70, 70 to 110 and 110 to 320 K gallons were studied. Considerable variation in time spent at herding, milking and washing was observed within each of the quota categories. The least efficient 25 % of herds within quota categories 30 to 55, 55 to 70, 70 to 110 and 110 to 320 K gallons took an average of 53, 66, 68 and 107 min for herding, respectively. The most efficient 25 % of herds within the same quota categories took 19, 26, 25 and 34 min for herding (Table 2). The least efficient 25 % of herds within the quota categories had a milk throughput of 78, 120, 127 and 141 gal/h, while the most efficient 25 % had a milk throughput of 152, 198, 216 and 343 gal/h, respectively (Table 3). A similar variation in efficiency within quota categories was observed for washing times (Table 4). This indicated that quota size was not the major determining factor in labour input to the milking process. Significant improvements are possible within each quota category.

Table 2. Average herding time (min) of least efficient (25 %), medium efficient (50 %) and most efficient (25 %) herds in different quota categories (n=114)

Quota category (gals)	Least efficient 25 %	Medium efficient 50 %	Most efficient 25 %
30-55,000	53	37	19
55-70,000	66	43	26
70-110,000	68	43	25
110-320,000	107	59	34

n=number of herds

Table 3. Average milk throughput (gals/h) of least efficient (25 %), medium efficient (50 %) and most efficient (25 %) herds in different quota categories (n=114)

Quota category (gals)	Least efficient 25 %	Medium efficient 50 %	Most efficient 25 %
30-55,000	78	122	152
55-70,000	120	145	198
70-110,000	127	179	216
110-320,000	141	222	343

n=number of herds

Table 4. Average washing time (min) of least efficient (25 %), medium efficient (50 %) and most efficient (25 %) herds in different quota categories (n=114)

Quota category (gals)	Least efficient 25 %	Medium efficient 50 %	Most efficient 25 %
30-55,000	63	33	19
55-70,000	54	31	20
70-110,000	58	35	25
110-320,000	69	47	29

n=number of herds

Factors affecting milking process efficiency

A range of characteristics considered to be relevant to times associated with herding, milking and washing were investigated, to establish the specific characteristics, which influenced the time taken for each of these tasks. This was achieved by identifying least efficient, medium efficient and most efficient herds at each milking task (herding, milking and washing) and investigating the frequency of occurrence of specific characteristics among those herds.

The spring-calved herds in the milk quota ranges (30 to 55 [29 herds], 55 to 70 [32 herds] and 70 to 110 [28 herds] K gallons were used as one group, since the least efficient, medium efficient and most efficient portions of these quota categories, respectively, were similar in their average times spent at the milking tasks (Tables 2, 3 and 4). The herds in the milk quota range 110 to 320 K gallons were excluded in this analysis, since they were recognised as a more diverse group (large quota range) and that average times taken for the milking tasks by herds in this quota category were considerably different to those taken by herds in the other three quota categories.

Herding

Eighty-five spring-calved herds (for which all data was available) ranging in quota size from 30 to 110 K gallons were categorised into three groups comprising 28, 29 and 28 herds, respectively, based on time taken for herding. These groups represented the least efficient, medium efficient and most efficient herds. Milk quota and cow number ranged from 57.8 to 66.1 K (average 63.2) gallons, and from 52 to 61, (average 57), respectively, across the three groups. Average time for herding for these groups was 73, 48 and 31 min per day, respectively. The factors investigated for their impact on herding efficiency included fragmentation of grazing area, the possibility of cows going directly to paddocks after milking, frequency of fresh grass allocation and drover transport. The relative importance of each of these factors to minimising herding time is shown in Table 5. Forty-three and seventy-nine percent of herds in the least and most efficient groups, respectively had the grazing area in one block. This resulted in the possibility of cows going directly to paddocks in a large proportion (79 %) of the most efficient herds compared to the least efficient herds (39 %). Allocation of fresh grass on a twice-daily basis occurred on 71 % and 50 % of least and most efficient herds, respectively.

Table 5. Percentages of groups (categorised as least, medium and most efficient at herding) having characteristics, which may potentially influence herding time

Characteristic	Least efficient (n=28)*	Med. efficient (n=29)	Most efficient (n=28)
Av. herding time (min)	73	43	31
Herds having grazing area in 1 block (not crossing public roads)	43	66	79
Cows may go direct to paddock	39	66	79
Fresh grass allocation on a twice/day basis	71	45	50
Mechanised transport for drover (quad, jeep, bike)	32	21	18

* n=number of herds

Milking

Seventy-five spring-calved herds (for which all data was available) ranging in quota size from 30 to 110 K gallons were categorised into three groups each comprising 25 herds, based on time taken for milking (clusters on/off). These groups represented the least efficient, medium efficient and most efficient herds. Milk quota and cow number ranged from 59.0 to 64.5 K (average 61.9) gallons and from 53 to 61, (average 57), respectively, across the three groups. Average time taken for milking these groups was 2.7, 2.1 and 1.7 h per day, respectively. The factors investigated for their impact on efficiency included the number of cows milked per unit, the milking facility, teat preparation and disinfection procedure, feeding method, cow collection and cow movement. The relative importance of each of these factors to minimising herding time is shown in Table 6. Sixty-eight and eight percent of herds in the least and most efficient groups, respectively had a cow:unit ratio greater than 7. The frequency of cows entering the parlour through doorways was halved (56 to 28 %) in the most efficient compared to the least efficient herds. The proportion of herds having exit gates operated from any point in the pit was more than doubled (30 to 68 %) in the most efficient compared to the least efficient herds. The 3'0" (0.91 m) herringbone parlour and manual feeding systems occurred more frequently in the least efficient compared to the most efficient herds. Teat preparation did not influence time for milking in this situation, since most herds in the overall group of 75 used similar procedures. A higher proportion of herds had foremilk drawn in the least (44 %) compared to the most efficient (24 %) herds. Teat disinfection was used by the majority of herds in all three groups.

Table 6. Percentages of groups (categorised as least, medium and most efficient at milking (clusters on/off) having characteristics, which may potentially influence milking time

Characteristic	Least efficient (n=25)*	Med. efficient (n=25)	Most efficient (n=25)
Av. milking time (min)	163	124	99
Herds in which number of cows milked per unit > 7	68	32	8
3'0" Herringbone parlour (0.91 m width)	60	72	44
Pipeline system	60	60	60
Teats not washed	88	92	96
When not washed, teats dry wiped	68	70	74
Foremilk drawn	44	48	24
Teat disinfectant used	76	76	84
Manual feeding in parlour	75	45	55
Entry to parlour through narrow doorways	56	36	28
Automated backing gate in collecting yard	0	4	4
Entry gate (operated from pit)	0	4	8
Exit gate (operated from any point in pit)	30	32	68
Drafting (operated from pit)	4	8	4

* n=number of herds

Washing

Eighty-five spring-calved herds (for which all data was available) ranging in quota size from 30 to 110 K gallons were categorised into three groups comprising 28, 29 and 28 herds, respectively, based on time taken for washing. These groups represented the least efficient, medium efficient and most efficient herds. Milk quota and cow number ranged from 59.1 to 65.3 K (average 63.2) gallons and from 57 to 58, (average 57), respectively, across the three groups. Average time for washing for these groups was 54, 33 and 22 min per day, respectively. The factors investigated for their impact on washing efficiency included the use of detergent in machine-washing on a twice-daily basis, the method and frequency of yard cleaning, the area of yard requiring cleaning and the possibility for cows to go directly to paddocks after milking. The relative importance of each of these factors to minimising herding time is shown in Table 7. Thirty-nine and twenty-one percent of herds in the least and most efficient groups, respectively, cleaned the yard twice daily. Sixty-three and seventy-nine percent of herds in the same groups had a yard area (which required cleaning) of less than 100 m^2. Fifty percent of herds in the most efficient group cleaned yards by using a hand scraper, while thirty-nine percent in the least efficient group used this method. However, this may be associated with yard size. Cows were able to go directly to paddocks after milking in 57 and 68 % of farms in the least and most efficient groups.

Table 7. Percentages of groups (categorised as least, medium and most efficient at washing) having characteristics, which may potentially influence washing time

Characteristic	Least efficient (n=28)*	Med. efficient (n=29)	Most efficient (n=28)
Av. washing time (min)	54	33	22
Detergent used twice daily	93	86	96
Hand only/hand assisted cleaning of yard	39	48	50
Frequency of yard cleaning (twice daily)	39	17	21
Channels in yard for water disposal	71	79	79
Yard area to be cleaned (<100 m^2)	63	56	79
Cows may go direct to paddock	57	59	68

n=number of herds

Discussion

The layout of the grazing area in one block (not crossing public roadways) and the possibility for cows to go directly to paddocks after milking were the two major influencing factors in reducing time spent at herding cows. While fragmentation of the grazing area is unavoidable on a number of farms, there are some instances where, non-dairy cows are grazing or maize/silage is adjacent to the parlour, and cows are being transferred across the public road for milking. This practise requires extra labour units. The blocks of land adjacent to the parlour should be confined, where possible, for the milking herd. The allocation of fresh grass at each milking may not be very time consuming if the paddocks are well laid out. This task took 16 and 5 min per day by the least and most efficient groups in the above comparison. However, it would be possible to improve time efficiency by allocating grass on a 24 h basis instead of a 12 h basis, while ensuring that the allocation was sufficient and weather conditions were not critical. Mechanised transport used by the drover did not influence herding times in a positive manner. This may be due to the fact that this type of transport existed more frequently on farms with fragmented grazing areas. The length, width and surface condition of roadways may have a significant effect on herding time. However, data to examine this issue is not available so far.

The data on milking times indicated that the number of cows milked per unit had a major impact on the milking time. The number of milking units is inadequate in many parlours, particularly when cows are at peak production. The current data also suggests that cows should not be required to pass through narrow doorways. Narrow doors at the entrance to the parlour restrict cow flow and limit throughput. Covering the collecting yard would eliminate the need for narrow entrance doors. Drawing of foremilk may have a negative impact on milking time. However, the drawing of foremilk is a necessary requirement according to the EC Dairy Hygiene Standards and is therefore not an optional practice in relation to time saving at milking. The data suggested that the presence of exit gates operated from any point in the pit would reduce overall milking time. The advantages of these exits might be more pronounced in larger parlours. Backing gates, entry gates and drafting facilities operated from the pit are likely to have a similar effect (as time saving devices) on milking time. It was not possible to deduce this from the data presented in this paper, since the occurrence of these devices was very low in all three categories of herds. The presence of these devices would probably eliminate the need for the milker to leave the pit at any time during milking. Milking systems in the future should be geared towards a one-person operation. The overall objective is to harvest the maximum volume of milk with the least amount of labour, under the least stressful conditions for the person and cow.

The size of the yard area to be cleaned and frequency of yard cleaning were the two major influencing factors in reducing time spent at washing. The reduced size of the yard area to be cleaned, in the more efficient herds may be due to a greater proportion of the yard being slatted. Reduced cleaning frequency may reduce time taken for washing. However, it must be ensured that a high standard of cleanliness be maintained. The possibility for cows to go directly to paddocks after milking and not wait in the yard also had a positive effect on washing time. Hand or hand-assisted cleaning of the yard did not influence herding times in a negative manner (the most efficient group at washing included a slightly higher proportion of those cleaning by hand compared to the medium and least efficient groups). This may be due to the fact that this method of cleaning is more frequent on smaller yard areas. The impact of frequency of detergent use and channels for taking water while washing yards was not evident, since a high proportion of herds in all three categories had these features.

Summary

Indications from the initial analysis of this data on the milking process suggests that the main time-escalating element of herding was the fragmentation of the cow grazing area (involves crossing public roads) and the associated inability to let cows back to paddocks directly after milking. This may be avoided in some instances by removing non-dairy cows/silage etc. to areas less convenient to the parlour and having the dairy cows adjacent to the parlour. The impact of roadways has yet to be determined. The main time escalating elements of milking were the inadequate number of milking units, the difficulty for cows in accessing the milking parlour through narrow doorways and the fact that in many cases the exit gates could not be operated from any point in the pit. Thus, upgrading of many parlours in respect to these characteristics is required. The main time escalating elements of washing were increased size of yard area to be cleaned and twice daily cleaning. This situation may be improved by increasing the slatted area of the yard.

References

Clarke, D. (1998) Human resources for New Zealand dairying. *Proceedings of Ruakura Farmers Conference – 'The business of farming'* pp. 57-63.

Frawley, J. (2000) Young people in agriculture – the worrying trends. *Proceedings of Farmers Journal Conference – Young blood – vital for a vibrant dairy industry* pp. 3-10.

Leslie, M. and Miller, D. (1998) What can you get out of a set of accounts. *Proceedings of Ruakura Farmers Conference – 'The business of farming'.* pp. 10-15.

New EC Dairy Hygiene Standards. Published by the Irish Co-Operative Organisation Society Ltd.

Reid, J. (1997) The on-farm labour situation in the New Zealand dairy industry: the present situation and beyond 2000. *Dairy farming Annual* **49** 177-187.

Watkins, M. (2001) Labour efficiency in large scale dairy units. Nuffield Farming Scholarships Trust. NFST Secretariat, East Holme Farm, Maresfield, Uckfield, East Sussex TN22 3AY. pp 14.

Labour Efficiency on our Farm

TOM DUNNE
Downing, Kilworth, Fermoy, Co Cork

Introduction

As participants in the Moorepark Labour survey, being involved in an alternative farm enterprise, and enduring the Foot and Mouth scare, our minds have been focused more than ever on Labour Efficiency on our farm.

What is Labour efficiency and how do we get it? Some people think that if we run instead of walk we will be more efficient. Others think machines will lead us to the promised land. Some say planning and organisation will deliver the goods. All of these delivered in the package of a system that suits your circumstances are perhaps the answer. What suits my farm situation may not suit yours, therefore we must be flexible. The system we choose will impact on our family lives, dictate our working conditions and how attractive our farms will be for future generations.

Farm Structure

It's a family farm partnership. There are three families in the partnership. Each family supplies a labour unit. There is no hired labour on the farm. A new agri-tourism business is run in parallel with the farm. This business has a separate manager. One of the partners spends up to 50% of his time working on this enterprise while the others help during the peak season.

The Farm

The farm is made up of 300 acres (owned and leased). Stock comprises 185 milking cows, cull cows, replacements and beef. The farm is stocked at 1 LU/ac. The farm is in seven separate blocks. Five of these areas are available to the milking cows for grazing at 0.7 acres per cow. Milking cows need to cross the road more than 50% of the time morning and evening. Contractors cut the silage and this year also spread the fertiliser from May onwards. The partners including DIY AI do all other work.

The milking machine is a sixteen unit side by side with 2'2" standings. It's a basic machine with no extras. The output is 140 – 150 cows per hour at peak. The entry and exit gates and head rail is operated by compressed air. One or two people milk the cows depending on the time of year and the availability of labour.

In Search of Labour Efficiency

Labour efficiency should not be an end in itself. It must always be in the context of a profitable business. Time spent on the farm could be reduced by the purchase of expensive machinery, but it might not be profitable to do so. This means that the system employed to achieve our farm production is the most critical factor in relation to labour efficiency. As managers of a business we must constantly question why we do things in a certain way and then perhaps why we do them at all. An example of this is the decision taken not to wash the cows before milking. This was unthinkable some years ago but experience has shown that it makes absolutely no difference to milk quality and is perhaps better for the cow's udder health. On the farm we try to operate a system that is simple, low cost, and repeatable from year to year if possible. We try to learn by our mistakes.

Critical Matters

On any dairy farm what are the critical things from season to season? The most important factor in a spring calving herd is that the cows calve compactly each spring. This is the key to managing labour. Calve in a block, breed in a block and dry off in a block. We usually dry all the cows on the same day. You have very heavy bursts of work, you can focus on one job at a time, and for this reason you are likely to get better results. Calving begins for the heifers the first week in February, the cows mid-February. The bulk of the cows are calved by mid-April. Breeding this year began on May 12th for the cows, and May 8th for the heifers. Angus bulls run with the Heifers. DIY AI was used for 20 days on the cows during which 85% of the herd was bred. Angus bulls were then run with the herd. This system will result (all things being equal) with around 50 replacement heifer calves being born. We usually keep 40 – 45 replacement heifer calves.

Breeding

Because we consider compact calving to be vital and as the Holstein bulls available have poor and worsening fertility for themselves and their daughters, we are using crossbreeding in our herd. We have used small numbers of Rotbunt and Norwegian Red over recent years. A large number of Swedish reds were used last year, resulting in 23 SRB heifer calves, accounting for half of our replacements for that year. All the cows bred to AI this year had SRB used on them. The hope is to breed a more functional cow with better fertility, better legs and feet. A more compact animal with better conformation is the goal. Also hybrid vigour should lead to a more efficient animal feed wise. A cow that goes and stays in calf, has no lameness, less mastitis and generally better health requires less labour. A herd of cows like this should require a lot less labour. Time will tell whether the SRB's will deliver this.

Management Practices

As cows calve they go to grass day and night and do not come back into the sheds. The labour saved with this practice needs no explanation. Feeding late in the evening is also practised to discourage night calving and has worked very well. The spreading of fertiliser by contractor has been very successful, the cost is competitive, and it has relieved us of the work at critical times. Up to four years ago we cut our own silage, but lack of manpower has made it impossible to continue with this strategy (it would still be cheaper to cut the silage ourselves). Covering the pit is now the only labour required on our part at silage time.

Investment in a load-all, while expensive has halved the time feeding silage as well as assisting in most tasks around the farm. A farm quad is used to herd the cows and dust the pastures. It saves a lot of time not to mention making the handling of bulls a safer job.

Cows are moved on a 24-hour or longer interval depending on the paddock. Temporary wires are used sparingly, which reduces work but not performance. Calf rearing systems around the country changed this spring with the FMD restrictions and our farm was no exception. A calf feeder, which is pulled behind the quad, was purchased. Calves were fed in batches of 20-25.The feeder holds enough milk to feed 4 batches at a time. Some of the calves were fed once a day some twice each day. Obviously the calves fed on once a day required less labour but their growth was affected compared with the calves that were fed twice a day. This has implications only for calves that are for sale. Once a day feeding works very well for calves that are being retained on the farm.

Record keeping

Using a computer programme to fulfil register requirements has proved to be timesaving and more efficient in the longer term. The large amount of data that needs to be stored and processed makes keeping the blue book in written form a very cumbersome exercise. I am looking forward to registering the calvings by e-mail next spring. Bookwork is taking more and more time. Our incomes are becoming dependant on good records. Agricultural byelaws, codes of Good Practice and many other forms of environmental constraints require our time to keep records. Losing the right to farm is the price for failing to find that time.

Lessons from the Labour survey for our farm

Specific areas that need attention become obvious for each farmer when they look at the data for their own farm. In the case of our farm, crossing cows on the road from the milking parlour to different blocks of ground uses up at lot of time. Washing the milking machine and cleaning yards is other routine work that takes time each day. Daily chores should be minimised or removed from the routine if at all possible. In the milking parlour there are 12 rows of cows for each milking, which is too many. The Solution to this is four extra milking units, which would reduce the throughput to nine rows. The addition of cluster removers on the then 20-unit parlour would facilitate a one-man operation. Milking machine washing is another chore that automatic washing would eliminate. Motorising the backing gate as well as fixing a yard scraper to the gate would help one man milking and complete another chore at the same time. The construction of a tunnel under the road would be a real labour saving possibility and would be the best labour saving move of all. The saving on the chore of herding (again helps a one-man operation) would be welcome, but also the reduced soiled water and slurry from the collecting yard. It would be reduced by as much as 75%. Our experience has been that one person versus two makes little difference time wise to the milking but it makes a big difference to have two people when herding and washing is taken into account.

Issues affecting Labour Efficiency in the long Term

As already discussed the farming system would have the biggest impact on the labour efficiency in the longer term as well as the shorter term. In this context, nothing would be ruled out as a possibility as far as we're concerned. This goes from on the one hand considering robotic milking and how it might suit your situation, to at the other extreme considering once a day milking. The latter in particular could provide possibilities for labour saving as well as expansion in a non quota situation i.e. in our situation some of the blocks of land would be available for grazing if the cows only needed to travel to them once a day. The farming system chosen by the Farmer impacts on his lifestyle, his social possibilities and family commitments. For farmers to take the attitude of older generations where labour on the farm took precedent over all other commitments is not sustainable or desirable in the modern world. Neither can we ignore the impact that our farming system has on the attitudes of the younger generation towards farming. If younger people have choices as to what career path they are going to take, we can hardly expect them to go farming if we don't make it attractive for them. A shortage of young people taking up farming as a career will make the labour situation impossible and will lead to the overburdening and isolation of those of us that will be left farming. The energy and enthusiasm of youth makes all the difference to any farm.

The returns from Agriculture will affect labour in the longer term. The ability to compete with other employment or finance machines to do the work depends on farm profit. We will hardly encourage our children to farm if incomes are very low.

Milk quotas have an impact on Labour efficiency at the moment and are likely to have for the future. Milk quotas discourage people who are actually milking the cows and are an enormous deterrent for young people entering the industry. Milk quotas effect our management decisions. They lead to inefficiencies, which put stresses on labour resources leading to strategies that are not labour friendly. In fact these strategies don't consider the labour implications at all. For example, changing feeding regimes in the springtime to limit production, overfeeding calves with whole milk forced to lease extra land with quota leading to extra stock to work the land. This gives a lot of labour with no profit. From our farm's point of view and probably from most other active producers, the sooner the milk quotas regime is dismantled the better, from a labour-efficiency point of view not to mention all the other obvious reasons.

Labour Efficiency is a challenge facing every farmer. Fulltime or partime how we organise our day is vital to our success. A challenge is there to be met and overcome. You are not successful farmers by accident you've put the work in. Farmers ask, "What will I do with all this time that's saved?" Perhaps you could spend it thinking of ways to save more time on the farm.

Planning for a Future in Irish Dairy Farming

THIA HENNESSY
Rural Economy Research Centre, Teagasc

Introduction

It is commonly remarked that Ireland has dramatically transformed itself in recent years. Rural and urban areas scarcely resemble their former selves and likewise industry and agriculture have undergone major change over the last decade. These changes to the economy in general and more specifically agriculture are a result of a number of combined forces. It is likely that many of these forces will continue to play a part in shaping the future direction of Irish agriculture and therefore must be taken into account by anyone who is planning for a future in dairy farming.

This paper will begin by outlining the issues that will influence the future development of Irish dairy farming and their potential impact. The issues addressed relate to the effect of the economic boom, demographic trends and agricultural policies. Given the issues that are likely to shape the future of Irish dairy farming there will be a discussion on how farmers can respond to these challenges.

Issues Affecting the Future of Irish Dairy Farming

The Celtic Tiger

Few economies have changed as radically and rapidly as Ireland. We have experienced exceptional growth. GDP grew by almost 70% from 1990 to 1998. This economic boom has had repercussions for agriculture. Nationally the importance of agriculture has diminished. In 1990 agriculture accounted for 10% of GDP and 15% of total employment compared to 5% of GDP and 9% of employment by 1999. Strong growth is projected to continue in the future and this will have an enormous impact on agriculture. The Celtic Tiger economy will influence the future direction of Irish dairy farming through three main channels.

Higher incomes

Industrial wages have increased by over 40% in the last ten years. This increase has resulted in a large divergence between industrial and agricultural incomes. As long as the current economic boom continues this divergence is likely to grow and will have repercussions for farming. Retaining farm numbers will be a challenge, as will attracting new young farmers into the sector. The cost of hiring labour or farm relief has also increased.

Inflation

Inflation averaged at 5.6% for the year 2000 according to the Central Statistics Office. Due to inflation farmers can expect a substantial increase in production costs. Costs such as labour, energy and services are all projected to increase substantially over the next number of years. The FAPRI-Ireland Partnership[1] has projected that such costs will increase by over 25% in the next ten years. Secondly, the purchasing power of incomes earned will be significantly diminished due to inflation. With the price of consumer products rising, the amount of goods that can be purchased with the average agricultural wage is declining.

Employment Opportunities

Unemployment levels have dropped from 16% in 1993 to 3.5% in 2001. For the first time in the history of the State the economy is operating at full employment. Although this is an excellent achievement for the economy and the people of Ireland, it has created problems for agriculture. Young people are lured out of farming by the prospect of higher paid jobs for less working hours. Further, farm labour is difficult and expensive to secure.

Demographic Trends

The Celtic Tiger economy is often cited for the decrease in the number of farmers in general and for the shortage of young farmers in particular. Entry into farming however, is subject to demographic influences that introduce degree of inertia into the entry process that may lead to declining entry even when economic conditions are favourable (Gale 1996). The demographic trends show that there are less young people living on farms. There are fewer farmers than there were a generation ago; these farmers are having fewer children, as shown by Table 1. The number of children on farms is projected to decline further. Hence, the potential base for new young farmers is naturally shrinking and this is impacting on the number of those entering farming.

Table 1. Number of farmers' children aged 16 to 20*

Years	Number of Children	Change
1981	44,412	100
1986	40,300	91
1991	35,359	80
1996	28,209	64
2011	12,075	27

**Source: Kennedy and Williams Report 1999*

The Kennedy Williams report projects that by 2011 there will be little over 12,000 children of school leaving age living on farms, i.e. between 16 and 20 years of age. That is 58% less than the 1996 estimate. If the potential number of future farmers is decreasing at such a rate, then the actual numbers will inevitably decline, unless there is more scope for young people from non-farming families to enter agriculture.

---

[1] The FAPRI-Ireland Partnership is a joint venture between Teagasc, the Irish Universities, other groups in Ireland, and the Food and Agriculture Policy Research Institute (FAPRI) in the USA.

The Policy Climate

There has been considerable change in the agricultural policy of the EU under the Agenda 2000 Agreement and it seems that EU farmers can expect even more changes in the future. Simultaneously there has also been policy change on the domestic scene. The most recent policy agreements that will directly influence Irish dairy farmers are the Agenda 2000 policy package and the new rules on milk quota transfer. Although these agreements secure agricultural policy over the next number of years there is continued pressure for reform of the CAP. For example Irish farmers may be faced with milk quota elimination in the not too distant future.

At the time of the Agenda 2000 negotiations, the "London Club" (UK, Italy, Denmark and Sweden) was in support of quota elimination. The agreement therewith was that milk quotas would prevail until 2008 under the Agenda 2000 Agreement with a review in 2003. Since then, some official support for quota elimination has been expressed in both Germany and Spain. Additionally, EU enlargement and the WTO negotiations may be a further catalyst to the dismantling of the quota regime. It seems that there is a possibility that EU dairy farmers will be faced with the prospect of milk quota elimination in this decade. It is probable that this will not occur until 2008 at the earliest. A later section of this paper deals with the possible effects of milk quota elimination on Irish dairy farmers.

Further reform of the CAP may be instigated by EU enlargement. Following the EU summit in Nice in December 2000, it looks likely that the first wave of countries is to join by the summer of 2004. The first wave consists of Poland, Hungary, the Czech Republic, Slovenia, Estonia and Cyprus. The process of enlargement will create difficulties for the Commission in relation to the CAP. The CEEC (Central and East European Countries) are highly agricultural and have large production potential. It is almost inevitable that on entry to the Union farmers in these countries will demand the same direct payments and support prices paid for agricultural produce in the EU. This will put serious budgetary pressure on the EU and the funding of the CAP. Some believe that EU enlargement may provide the impetus required for further and more significant reform of the CAP.

The impending WTO negotiations will generate further pressure for agricultural policy reform. The next agreement is likely to secure commitment from the EU to reduce the volume of subsidised exports. This will impact negatively on the price paid to farmers for produce. In addition, the EU will be obliged to provide increased access to its dairy market to other exporting countries like the US and the Cairns group.

Clearly, we can expect policy change in the future and undoubtedly it will influence the direction and development of the Irish dairy farming sector. Since the likely changes stemming from the sources discussed above are not yet known, the remainder of this paper deals with the impact of Agenda 2000 and domestic policy on milk quota transfer. There is also an examination of a milk quota elimination scenario.

The Agenda 2000 Agreement

The principle of the Agreement is to distance agricultural policy even further from price support and to increase direct income support while maintaining production quotas. The intended objective of this policy is to make the CAP less trade distorting and less production inducing in the eyes of the WTO. Further, it is intended that these changes will make the CAP less difficult and costly to extend to CEEC in the event of EU enlargement. The details and workings of Agenda 2000 were widely documented and published at the time of Agreement. For this reason, they shall not be reiterated here.

Domestic Quota Transfer Policy

Policies with regard to the transfer of milk quota in Ireland have recently undergone change. Previously milk quota could not be freely traded and the most common means of permanently acquiring quota was to purchase land and quota as a going-concern. Private leasing was a common avenue for temporary expansion. Lease price was determined privately between lessee and lessor. Such arrangements became so common that in 1999 every three active milk producers supported one "dormant producer".

The new arrangements agreed by the Irish Department of Agriculture, Food and Rural Development (DAFRD) require all "dormant producers" leasing out quota for longer than 3 years to recommence production or to sell quota into the restructuring scheme. Active milk producers may then try to acquire quota from the restructuring scheme at a fixed price, 136p per gallon in 2000 and 124p in 2001. Allocation of quota from restructuring will be operated on a priority basis, where priority will be determined by quota size.

The impact of Agenda 2000 and the new quota transfer rules on typical dairy farms will be presented in the ensuing section of this paper.

Facing the challenges

The Outlook for Dairy Markets and Prices

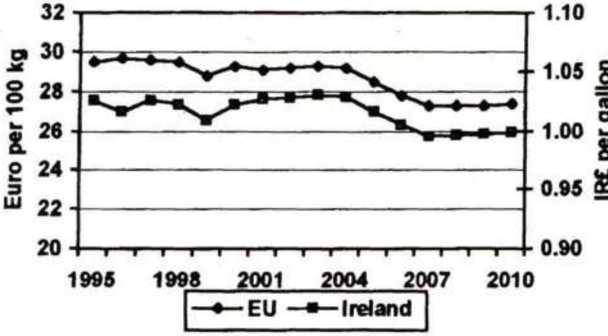
The FAPRI-Ireland project produces annual projections of agricultural commodity prices. Projections, covering a ten-year period, are based on the best possible information available at the time and incorporate agreed policies only. The following text summarises the results and projections for the dairy sector.

Donnellan (2001) reported that after a period of weakness in 1998 and 1999, dairy markets strengthened in 2000. Export prices for both skimmed and whole milk powder increased in dollar terms while butter and cheese prices remained relatively unchanged. However due to the continued weakening of the euro against the dollar over the course of most of the year, prices for all commodities were up when measured in euro.

Following the recovery in international dairy market demand in 2000 conditions are projected to remain favourable in the medium term. Demand in East Asia has strengthened considerably and Russia is projected to increase its imports of butter and cheese by 100% on existing levels over the course of the projection period. Consequently prices are set to improve over the projection period when measured in dollar terms. However, with the dollar projected to weaken against many major currencies over the period, the outcome may not be as favourable when expressed in euro terms.

Projections for the Irish producer milk price show prices declining slightly from current levels out to about 2004. After 2004 a more appreciable decline takes place as the impact of increased quota and lower intervention prices across the EU, as agreed under Agenda 2000, feeds through to farm level milk prices.

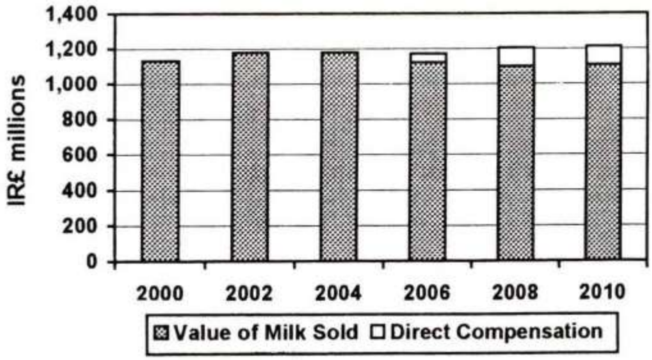
Figure 1. Irish and EU producer milk price (3.7% fat)



Source: FAPRI-Ireland Partnership Model (2001)

A direct compensation package also forms part of Agenda 2000. The Figure 2 (below) shows the anticipated revenue accruing to the milk sector over the projection period on a calendar year basis.

Figure 2. Projected Irish Milk Sector Revenue[2] for selected years



Source: CSO and FAPRI-Ireland Partnership Model (2001)

There is a progressive decrease in milk sector output value out to 2010. By 2010 the intervention price reductions and the general EU quota increases will be fully implemented, as will the direct payments package. While the value of milk produced by the sector will decline to 2% below the current level, this decline is counteracted by the introduction of direct payments as agreed under Agenda 2000. By 2010 sector revenue, which is shown in nominal terms, is up 6% relative to 2000 levels.

[2] Milk Sector Revenue = Value of Total Milk Output + Total Milk Direct Payments

The Impact on Irish Dairy Farms

As shown above, the value of dairy output is maintained in nominal terms, in other words the price reductions occurring under Agenda 2000 are fully compensated. FAPRI-Ireland analyses show similar results for the beef sector. However, high rates of inflation mean that farmers will be subjected to a price cost squeeze. Strong growth and inflation rates, higher than those experienced in recent years will result in continued increases in production costs. Fixed costs are projected to increase by 15 to 20% thus impacting negatively on farm net margin. Farmers who do not respond by increasing efficiency or enlarging operations will be exposed to a price-cost squeeze. The message for farmers is, as it has been for many years, it is necessary to run faster in order to stand still.

Larger and more progressive farmers will be able to maintain or modestly increase incomes in real terms through expansion of milk quota and purchase of currently leased quota. However, smaller farms with a quota of 20,000 gallons or less, which have a poor historical growth record and cost structure will be unable to expand milk quota at the current fixed restructuring price of 124p per gallon. It is projected that in a number of years such farms will sell quota into the restructuring pool and cease farming. The exit of these farmers is the result of a combination of push and pull factors. Diminishing margins, unaffordable expansion and rising living and production costs push farmers out of the industry. Simultaneously, the attractive sale price of quota and the lure of higher off farm incomes pull farmers out of the sector. The projected high growth rate for the rest of the economy should ensure a supply of off-farm employment opportunities. It can be concluded that some 11,000 farmers, may find that the future of their farm is not viable and some may exit dairy farming. The exit of these farmers will increase the availability of quota through the restructuring scheme and therefore enhance the opportunities for prosperity for the remaining farms.

Teagasc research has examined typical Irish dairy farms and estimated the level of expansion possible and probable between now and 2007 Hennessy (2001). The resulting effect on income over the period was calculated. Results showed that for a typical dairy farm of 40,000 gallons an increase in quota of 30% would result in an 11% increase in incomes in real terms, that is allowing for inflation. Any further expansion in quota was unlikely to boost incomes in the short term given the cost of purchasing plus the cost of the additional required resources. Furthermore, the likelihood that farms would be able to secure additional quota above this level is minimal. For larger dairy farmers acquisition of milk quota may be more difficult, as they do not qualify as a priority group under the new quota regulations. Large farmers are expected to maintain their current income levels in real terms by purchasing quota which they previously leased, effective cost management and through the strategic management of the dry stock herd in order to maximise the receipt of direct payments.

The Effect of Milk Quota Elimination on Irish Dairy Farms

An analysis of the impact of milk quota elimination on typical farms is presented below. It is assumed that quotas are eliminated in 2008 and there is no phasing out process[3].

[3] In reality immediate elimination of quota is unlikely. It is more likely that a gradual increase in quota over a long time period will occur.

An estimate of the level of production required to maintain living standards, i.e. to be no worse off, following quota elimination is presented. The feasibility of achieving this is also examined.

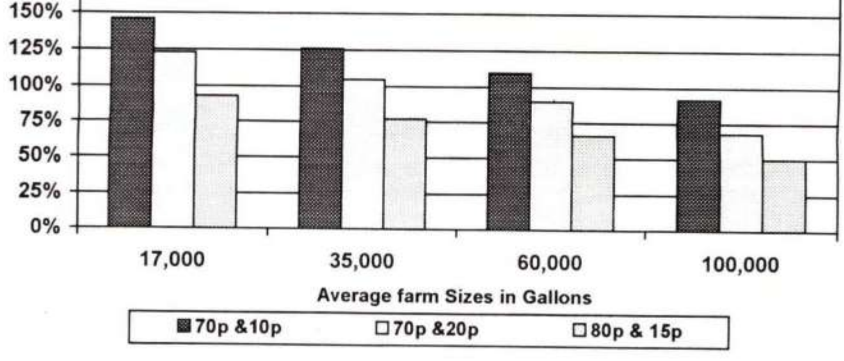
A drop in milk prices will inevitably accompany milk quota elimination. Research shows that due to Ireland's product mix, prices may not fall as low as world market rates but will be approximately 30% below current prices, FAPRI (1998). Some form of compensation is likely to be paid in a post quota situation and it would probably be linked to historical production. The impending WTO agreement is likely to prohibit compensation of new production above that produced during the GATT era. Here three possible price and compensation scenarios have been assumed.

70p per gallon plus 10p compensation on 1998/99 production.
70p per gallon plus 20p compensation on 1998/99 production.
80p per gallon plus 15p compensation on 1998/99 production.

Milk quota elimination will also affect input prices. The projected increase in input prices under Agenda 2000 has already been discussed, i.e. inflation and the effect of the Celtic Tiger. However, many believe that some input prices would fall following quota elimination. Prices of agricultural based inputs such as foodstuffs and machinery are linked to agricultural output prices. Where output prices fall these input prices will inevitably fall, such was the case following deregulation in New Zealand. Conversely, non-agricultural inputs such as energy and labour will not decrease in price, as they are not dependent on the buoyancy or otherwise of the dairy sector. It is difficult to project the magnitude of price reductions in a non-quota scenario. It is assumed here that the reduction that is likely to occur following quota abolition will negate approximately 50% of the prior increase and post-quota production costs would be between 6% and 7% higher than 1999 costs, albeit less the cost of leasing milk quota.

Given the expected milk price reduction it is evident that expansion will be necessary in order to maintain current income levels in a post quota scenario. Recent Teagasc research (Hennessy 2000), calculated the level of expansion required on average farms to maintain income levels. This is presented in Figure 3.

Figure 3. Level of expansion required to maintain income levels



As shown, farms currently supplying 17,000 gallons would need to increase current production by 140% in order to maintain incomes if the milk price fell to 70p per gallon and 10p compensation was paid. Production would have to increase by between 120% and 85% in the subsequent two scenarios if incomes are to be maintained. Farms supplying 35,000 gallons will need to expand significantly. In the first price scenario 88,000 gallons of milk is required to maintain incomes, an increase of 125%. Production needs to increase by 110% and 75%, which is 80,000 and 66,000 gallons, in order to maintain current incomes in the other two scenarios. The situation is the same for larger farms. Those with a quota of 60,000 gallons need to expand by 110% to 70% depending on the price scenarios. Similarly, those currently supplying 100,000 gallons need to increase production by between 90% and 50% depending on prices and compensation. Clearly substantial expansion of production is required by all farm sizes if incomes are to be maintained.

It is often argued that there is large production potential on farms lying dormant due to the quota constraint and thus production could be increased without investment. Yields are depressed due to shortened lactation periods and avoidance of super-levy payments. Additionally, specialisation in dairy production on farms is low due to poor distribution of milk quota across many farms as shown by Table 2.

Table 2. Average level of specialisation in dairy livestock 1999

Size '000 gallons	**17,000**	**35,000**	**60,000**	**100,000**
Avg Total Livestock Units 1999	53	87	119	200
Dairy Cows % of livestock units	48	58	59	62

Source: National Farm Survey 1999

Specialisation is quite low particularly on farms with smaller quota. Hence, most farms have a large number of livestock other than dairy cows. Teagasc research has estimated the number of cows that could be kept on farms if they were substituted for other livestock. This figure was calculated through consideration of land, labour, housing and milking parlour capacity.

In addition to increasing dairy cow numbers it is also likely that productivity per cow would be improved if milk quotas were removed. Data shows that typically yields per cow improve at a rate of 1.3% per annum in Ireland. Thus by 2008, present deliveries per cow will have progressed significantly. Moreover, Teagasc have estimated that deliveries could be increased by 9% by lengthening lactation and by 3-5% by sale of milk currently fed to calves. Cow numbers can be increased through specialisation and it seems that productivity per cow can also increase. By combining these factors the average production potential of Irish dairy farms in a post-quota situation can be determined. This potential is presented Table 3.

Table 3. Potential post-quota increase in average deliveries per farm

Size '000 gallons	17,000	35,000	60,000	100,000
Avg Deliveries 1998/99	17,000	35,000	60,000	100,000
Potential post-quota deliveries	28,100	55,800	79,700	138,400
% Change 98/99 to post-quota	65	43	37	38

A typical farm that supplied 17,000 gallons in the 1998/99 milk year has the potential to increase deliveries by 65% to an average of 28,000 gallons without any additional investment. The other three size groups can increase deliveries by 43%, 37% and 38% respectively.

As was shown substantial expansion of production is required if farmers wish to maintain real incomes. Achieving this expansion is not possible within current resources. For example the typical farm supplying 17,000 gallons in 1998/99 has the potential to increase milk production by 65% on existing resources. However, increases in production to the order of 85% to 140% are required if real income is to be maintained in a post quota scenario. Clearly capital investment is necessary in order to expand production to the levels required. The situation is similar for the other farms although on larger farms the existing potential brings production closer to the required level.

The amount of capital investment necessary to maintain real income was estimated. Results showed that investment costs varied depending on the price scenario and the farm size. In some instances the capital requirements were excessively large especially given the level of income produced. For this reason, the research focussed on the cash surplus remaining following annual repayments. It is found that up to one-third of producers currently supplying less than 35,000 gallons would find investment infeasible, given the level of cash surplus remaining. Furthermore it was shown that where investment was feasible between 20% and 30% of the current population, depending on the price scenario, would have a disposable income lower than the minimum wage.

Although all farm sizes are capable of significant expansion in production both before and following investment, this expansion is not sufficient. Investment in order to expand further is impossible for some farms. Clearly milk quota elimination, under the assumptions that have been made here, would have a negative impact on supplier numbers.

Conclusions

We see that in both situations small farmers are vulnerable to the policy changes and the impact of the strong macro economy. In the Agenda 2000 case, farmers supplying 20,000 gallons or less become non-viable by 2003/2004. It is expected that some of these farmers will sell theirs quotas into the restructuring pool and reallocate their land to either letting or cattle farming. At least under Agenda 2000 these smaller farmers have a valuable asset to sell namely quota and their land commands a reasonable price on the letting market while there is still strong demand from other dairy farmers. If these small farmers are still in existence when quotas are abolished they will need to make considerable investment in order to earn even the minimum wage. This research has shown that for a large proportion of farms that this would not be possible due to the onerous repayment requirements. It may be necessary for these farmers to exit dairying. Exit from farming at this stage would not be as profitable as the asset value of milk quota has been eroded and land rental and sale values may also have fallen.

If there is a large exodus from farming prior to milk quota elimination then quota will be available on the restructuring market. If those farmers who remain in dairy farming can increase their production by acquiring quota then their future following quota elimination may be brighter as they will be in a better starting position and therefore will not need the same magnitude of expansion. Additionally, if the land market is adversely affected by the elimination of quota, this is also beneficial for the remaining farms, as the cost of expansion will be reduced.

Final Points to Consider

The Celtic Tiger boom has diminished the overall importance of agriculture to the general economy. This is a trend that is likely to continue especially as the number of farmers will probably continue to decrease.

Inflation is rampant in the Tiger economy and will impact negatively on dairy farming. Costs of production will increase while output prices are relatively frozen under the Agenda 2000 agreement. Farms will be exposed to a price cost squeeze and the purchasing power of incomes will fall due to inflation. Effective cost management is crucial.

Expansion of milk quota is necessary to maintain purchasing power. Smaller dairy farms will find expansion unaffordable at the fixed quota-restructuring price of 124p per gallon. They will be pushed out of farming by poor profits and pulled out by the attractiveness of quota sale and employment in other sectors. The exit of smaller farms will allow remaining ones to grow and thus to maintain incomes in real terms.

Quota abolition will affect all farm sizes. All would need to increase output considerably in order to maintain living standards. Although, large potential currently exists on farms to increase output (even before investment), this is insufficient. Capital investment requirements for most farms are large, repayment obligations are burdensome and incomes derived are still meagre. In general it is likely that milk quota abolition will not pose a favourable opportunity for most of the population. However, the exceptions to this are those currently leasing the majority of their quota or those who have a large amount of under utilised milking parlour and housing capacity.

Finally we can expect that EU enlargement and the WTO negotiations will instigate further changes to the current policy framework.

References

Donnellan, T. (2001) Agricultural Sector Outlook for Ireland. *Outlook 2001*. Teagasc, Dublin 4.

FAPRI (1998) Elimination or expansion of milk quotas – impact on European milk supply, demand and prices. *Proceedings of the 1998 Agri-Food Economics Conference* Teagasc, Dublin 4.

Gale, F. (1993) Why did the number of young farm entrants decline? *American Journal of Agricultural Economics* **75** 138-146.

Hennessy, T. (2001) The outlook for farms. *Outlook 2001* Teagasc, Dublin 4.

Hennessy, T. (2000) The changing structure and production potential of Irish dairy farming in the context of quota abolition. *Proceedings of the 2000 Agri-Food Economics Conference* Teagasc, Dublin 4.

Kennedy, K. and Williams, J. (1999) A study of the likely demand for training in agriculture up to 2011. Economic and Social Research Institute of Ireland, Dublin 4.

The Irish Milk Processing Sector

JOHN O'REILLY
Davy Stockbrokers, 49, Dawson Street, Dublin 2.

Introduction

Milk is a super product, and encouraging people to invest in dairy companies is not difficult. Advances in technology and knowledge create opportunities for profitable investment in milk. Also increasing health and nutrition awareness on the part of the consumer and proactive interest in, and management of, their own well-being, means that the milk processing sector will remain attractive for investment. However, it is important that stakeholders (suppliers and shareholders), as potential change agents in the dairy sector understand that there is no quick fix solution for the culture shift that is required. It is important that farmers understand that they are part of the change process, not independent of it, and that Irish milk processing is what it is, not in spite of farmers, but perhaps because of farmers.

If you want your industry to change, then you must be open to change. If you don't want to change, then you are the problem – farmers either directly or indirectly, own the dairy industry, and it cannot change radically without your agreement or support.

As an observer and a commentator on the food industry, I know that it is the entrepreneur or the executive (with an entrepreneurial flair), which brings about change in a sector. Entrepreneurs are creative. They invent new things, new ways of doing things. New things, ideas, products, processes, challenge old things, usurp them. The creative process is thus destructive. It may not be possible to have the former without the latter, but equally, if the latter is shunned (i.e. the status quo is protected), the former may not be possible!

The creative processes, take advantage of the fact that most people (for genetic and cultural reasons) try to avoid risk. An edge is gained by creating uncertainty for others. Innovators foresee that things can be very different to the way they now are, to how most people see them, or how they wish to see them. There are no facts to support an innovative product or process. There is no ready market for innovation. Innovation, or more accurately radical innovation, creates a market where none existed. To go for it the entrepreneur must rely mostly on gut feel, instinct or intuition and not analysis. The process is also unpredictable. Often times, the final outcome, modified by the process itself, can only be known in its completion, not in its anticipation.

If we want a different dairy industry, then we may need creators and not minders. In fact, the history of industrial change, says this is an imperative, but the cultural context has to enable this to happen. History also says that industry outsiders are the key change agents as an industry's prevailing culture may lock it onto a particular pathway, a dogmatic one that closes off other possible ways of doing things. Bringing about change in a firm or in a sector from within is very difficult; the record of success is poor. The starting point has to be culture, but how to change this? The future of the Irish dairy industry is dependent on its culture. Culture is the contextual system of meaning, values and beliefs, which govern how things are seen, how things are done, and how it is believed things should be seen and done. Everybody is bound up with this. Culture influences all it touches and is itself influenced reinforced or changed, in the process.

Industry change is more than about assessing the market opportunity for this or that product or technology. You only get to this stage if you are open to the idea of doing something different with all that this involves in risk, uncertainty etc. You don't change the room by moving the furniture about. You won't change the room if you view its boundaries as fixed.

How is milk seen? *As farm output? As a basic product? As a complex source of health and nutrition for a consumer audience now more focused and ever more demanding on these issues?*

The outcome is determined by the structure. Thus, how we view milk determines what we do with it, but it also determines what we don't do with it. If we see it chiefly as farm output then we don't see it as food; most effort will be made to improve production efficiency and profit at farm level. Support will be biased towards education and. If we see milk as basic product, the industry will be characterised by commodity production and processes and everything done will reinforce this condition, a condition that will be presented as unavoidable. If milk is seen as a source of health and nutrition, then this will shape attitudes to spending on research and development, the commitment we make to extending our scientific knowledge and technology, the type of learning and training we believe we need, want and invest in. Also it will reflect our attitude to investment spending, to profit and to the business enterprise itself.

Is the culture one, which inclines farmers and suppliers to view investment in processing, and profit as farm income foregone? Is the culture one, which inclines executives to stick to familiar pathways and to avoid operational and financial risk? For example, there is little operational risk in commodity production or selling. Financial risk is also small. Is the culture one, which causes Governments and regulatory agencies to place the interests of production above those of consumption?

A culture needs to be open to new ideas before it can assimilate these. This is true for the individual or any collection of individuals - family, team, club, firm or society. A culture set in its ways - opposed to new ideas, not only does it not easily accept change but fights resolutely against it. Even where there is openness to change, bringing this about is no easy task. It is a process that needs very careful execution because, if botched, the openness that was there will be substituted by strong fundamentalism. Where there is antagonism to change the tendency is for people to redouble their efforts in support of existing ways. Firms do this also. When faced with an innovation, the tendency is to beat back innovation by perfecting the old!

People tend to behave in one of three ways. Do as they always do; do as others do; or strike out on their own. Most fall into the first two categories, but this can create tensions. The more feedback that is positive, the more the action will be supported and the more people that will lend their support. In this instance people migrate from the *status quo*. Over time, the new state becomes the *status quo* and becomes as heavily defended as its antecedent state. Change is a dynamic process; it must be a continuous process. It is also dialectical in the sense that what may be strong today can transform to weakness under different circumstance. An organisation open to change is potentially forever changing. Change should not be a process with a prescribed or necessary ending. Hence the outcome of change can be unpredictable.

From this, the following can be observed about businesses. The more successful they are the more change resistant they become. This is understandable if one thinks about it. A successful company does things in a certain way to be, or to remain, successful. This becomes hereditary and routine for its staff. Routines establish order; they define the limits of what one may do (and what one may not do). They are a control mechanism, which channel people along a chosen pathway. A firm's reward system is linked to how well or otherwise its staff adheres to the organisation's rules or, more widely, its culture. As long as this (and its products) are adapted to the environment, it will be successful. However, the big risk is that in an environmental change it becomes difficult for staff to adapt, all the more so if routines don't permit this. So, in a very contradictory way, success is a major contributor to a firm's failure to adapt. In fact, bringing about strategic re-direction from within a firm is very difficult, as is revealed in the observation that probably less than 20% of enterprises have successful cultural, and therefore corporate, makeovers.

Like organisms and species, firms can be appropriate to a particular environment or circumstance but subsequently inappropriate. McDonalds is a case in point. It is finding it very hard to sustain a business model that was appropriate for the 'baby boom' period (nearly 4 decades ago) but appears to be less so to day. Incremental changes to the model are failing to sustain its historical growth rate. More radical change may be required.

Think of an outstanding innovation in milk e.g. Mueller Dairy Desserts. Mueller made yoghurt by a new means. Similarly, Cuisine de France makes bread in a very different way and in a different value network to plant - baked bread. Both companies were outsiders. Their innovations developed new categories and took share from established players. Both lead their categories.

Two further examples help to elaborate the point. These are Baileys and Ryanair. Both invented new markets, which they dominate respectively. Ryanair did not compete with Aer Lingus for the latter's customers. It discovered an audience, which had never flown previously or would do so less frequently if Ryanair did not exist. Baileys invented Irish cream liqueur. Its success attracted many imitators, but all compete in the restricted market space not dominated by Baileys.

The essential points of these anecdotes are as follow:

- Radical innovation typically comes from outside an industry, while established players typically focus on improvements to existing products or processes.
- Inventing and developing a new category or market and then dominating these represent really successful strategy.

It can therefore be claimed that good strategy is about:

- Refusing to accept the established order of things
- Foreseeing the future shape of things
- Creating uncertainty in products or markets for established players
- Good timing and building momentum behind first mover advantage

It was said at the outset that change and innovation are individually led and not collectively arrived at. Innovation is creative and highly intuitive in nature. The probability of its success cannot be proven in advance. In fact, a heavy reliance on analysis will almost certainly fail to arrive at an innovative solution. This is because forecasts tend to work off the present and the known and cannot deal with discontinuities. An innovation is a discontinuity for an established product or market.

I strongly believe that good strategic thinking is a highly personal activity and is not the selection of an external off-the-shelf solution. Outsiders can help by way of critique, but not otherwise. Successful strategies are imitated (remember what was said about people doing what others do). In this way an entire industry can change the way it sees and does things by following a leader. We therefore, need leaders in whom we trust to enable us to take the risk that change involves. Inspirational leaders do not travel familiar pathways.

If it is not axiomatic that an industry outsider must lead change, the evidence nonetheless strongly supports this proposition. Thus, whilst it can be argued that the Irish milk processing industry needs a radical shift in attitudes, there is a high probability that this will have to come from an industry outsider. As the arrival of a corporate outsider seems unlikely, the shift will have to be driven by changing attitudes within the industry (unlikely for the reasons mentioned), or via the recruitment of individuals from outside the traditional channels of education, training and recruitment. However the industry will have to be more attractive than at present, absolutely and relative to other sectors, in terms of reward, challenge, opportunity and fulfillment.

Recruitment of a different managerial mindset cannot happen in isolation. A new management outlook will not succeed in the context of an historical, unchanging ownership\supplier attitude, especially if this is risk averse. New ideas in backward looking organisations perish for the simple reason that a firm's hierarchy is likely to be controlled mostly by those associated with its past; these will most likely want to repeat the past. They tend to look in the rear view mirror to go forward!

Accidents can happen. Unique circumstances can bring like-minded stakeholders (management, shareholders, suppliers) together, i.e. when the interest of all those involved is mutual. This is the exception. Typically each firm is a struggle between the guards of the *status quo* and those who want change; the guards usually win out for the simply reason that they occupy the senior positions and put in place structures that honor and respect them and their views. In a study some years back it was found that 10% of people in an organisation are fundamentally change-resistant and that a similar number want continual or continuous change. The remaining 80% are not fundamentally opposed to change but will only buy into it when it is credible for them and is well led. Heaven help an organisation that attempts change but makes a mess of it!

Increasingly one becomes sceptical of the value of grand plans for industry restructuring based on some romantic vision for the future. I am persuaded in this by more recent readings on change and innovation, as this has occurred in many industries, sectors and categories. Outsiders or individuals who dream a different way to markets, products and new processes are the key actors in this. The idea that to dream uninhibitedly is vital to good strategy has gained ground in recent times, and that over-reliance on financial analysis and the use of metrics based on historical circumstance or performance is of limited value in this process.

Conventional analysis starts from where we are and as noted finds it hard to base assumptions on anything other than current trends. Typically therefore forecasts have difficulty in envisaging change. One can put up lots of data and figures about the dairy industry (Irish and overseas), and draw lots of conclusions. Suppose the IGA dairy conference actually took place when it was first scheduled in April (instead of September). A most significant event would not have been foreseen, i.e. Kerry's takeover of Golden Vale. Insofar as it was not anticipated, Kerry's move constitutes a discontinuity as far as existing assumptions about the industry are concerned. This event will cause other developments to take place. The majority dismissed the probability of success,, but when this was perceived to be likely, many of the doubters became zealots.

It is impossible to predict the future, but it won't necessarily be an extension of the present. For this reason, the Irish milk-processing sector will evolve in a way that is not predictable. Some catalyst, or a number of catalysts will cause it to follow a trajectory that won't be a trendline extension of today. The trajectory may have better or worse outcome than results from current circumstances. It is, of course, possible that it won't change at all, but given the apparent progress taking place elsewhere in the world dairy industry, this would be highly regrettable. Although not being able to predict the way or course of change, it is possible to say what won't happen, and this is via another top-down industry report. Suppose that the only way forward for the meat industry is value added produce. As a premise the data shows that little value added exists. So it can be concluded that unless value added is increased the industry will struggle and have no economic future. This kind of circular thinking is widespread. Worse, it is dangerous. Typically these reports observe the current situation very negatively. Many of these highly aspirational reports have contributed to the poor perception of the food industry, including its constituents like milk.

The argument and conclusion of these reports may be brilliant but the premise may be deeply flawed, to such an extent that un-questioned policies may be introduced, investment made, and actions taken which may dis-improve industry structure, output, income and profit. It could be argued that a better premise or starting point would be to acknowledge the real world and not the fantasy world of unproven riches from ascending the value added chain. Increasingly there is a view that firms should think very carefully before moving away from their competence i.e. what they really excel at (think of a competence in terms of Honda and small engines, Sony in miniature electronics). This is made up of the knowledge they possess, their accumulated learning, their technologies and how these all come together to produce products or solutions that are defining either in final product form or as an essential element in final product. Too often, for reasons of fashion, for stock market approval or the ambition of executives, companies move into new areas of activity, believing these to offer better rewards. Such moves are rarely successful.

There are several reports on the milk industry that dwell on the need for scale. Usually it is about production scale, rarely about relative scale in market or product segments. However, the latter is of huge importance, particularly where price is not the attribute, which secured it. Scale should be the outcome of having an advantage in product or process. It should not be confused with size. Size can be built. Scale needs to be earned.

For the past decade or so, talk has been about industry concentration - playing the savings game. This is a finite game. It adds no value *per se*; merely redistributing existing value. It only adds value if the savings generated are re-invested and are not immediately distributed. This has not happened. So what's so great about rationalisation? There is no vision in a policy of rationalisation if all it leads to is dis-investment in the sector. This may not be a problem today in the milk processing industry, but it could be so in a quota-less environment. A unique focus on rationalisation is the outcome of a mindset that is tired, one that sees the horizon as the limit and not as the standing point from which to view another one. It is one which is essentially closed to future possibilities, a minder rather than a creator, one that prefers the known to uncertainty and one that is probably more process than product driven, more production than consumer want driven.

It is unlikely that the future of milk processing will be defined in, or as a consequence of, an industry report. It will be defined by change which the prevailing culture enables; whether by a change agent, innovator, strategist or however you define anyone who refuses to accept things as given, as immutable, or the natural right of long established parties and who passionately pursues his\her dream. Initially this will be decried, fought against, but ultimately it will be followed if it is perceived to have a high probability of success. Followers are just that - followers. Leadership is what counts. In business, leadership results in better margins and better returns on capital.

Change involves displacement, and so it may be that some existing operators will be pushed aside in this process. So be it. Establishment payers are authors of their own downfall. To try and protect these is to stand against change. This is pointless, however apparently initially successful. It's a bit like the canal barge operators. Building bigger barges appeared smart for price reasons because there was still a market for barge transport well into the railway era. This is consistent with how markets (i.e. people behave). There is always a minority of late adopters of change, but eventually this minority becomes too small to support an industry, however rationalised it may be.

If the milk processing industry is to develop, and adapt to a changing environment, it must evolve a culture that if not at the edge, is equally not opposed to change. Knowledge and technology, education and training, as key influences of beliefs, meaning and values, are drivers of culture, and as a country we must invest in these if we want to be leaders in milk processing. This is possible but we are not good at this kind of central policy making and planning. So ultimately, change in the milk processing sector will be led by innovative individuals.

In the physical world, the organism cannot advance ahead of environmental change. But in the human world it is possible to dream or imagine a world quite different to what exists and to do things, which cause the world to adapt to our dream or imagination. This is what innovators do. Biology informs you that an organism, which is not adapted to, or is not capable of adapting to a changing environment, will perish. Not quite the same fate, at least not so quickly, awaits a firm or an industry, which fails to adapt.

In large part, farmers control the milk processing industry, directly or indirectly. Their stakeholding (as suppliers, shareholders, indeed customers) is substantial. Thus potentially farmers are significant agents of change, but they are also stout defenders of the *status quo*. Where they stand will depend on which role they play - defender or attacker. Behaviour will be influenced accordingly. Whichever role and mindset predominates, this will shape the business and industry given the ownership structure. For example, if farmers measure performance exclusively by reference to the short term, then almost certainly they will preside over organisations which are anti-change, which recruit people of this mindset and which leave progress and wealth potential to others, the others in this case being overseas.

Farmers have a crucial role to play in the development of the industry. The dairy industry is what it is, not in spite of farmers, but because of farmers. However, too often they behave as though they have no responsibility, that they are victims in the equation. This can be used to legitimise their demands - demands that may be excessive or inconsistent with sustainability, never mind progress. If the industry cannot be said to be in rude health strategically or operationally, and if a strategy is required to change this then farmers have a key role to play. A big change in attitude on their part is required. However, it is naive to suppose that it is only farmers who may need a change of attitude. Their representative organisations need to change to ones whose convictions transcend political self-interest. Governance needs wholesale change. It is no longer acceptable that farm production has precedence. Education and training establishments need to be re-missioned. The focus of food science education needs to change with consumer wants rather than milk its starting point. Food research needs to become more independent of food corporates and needs to be de-coupled from fee income.

Milk is a great product. The issue is whether we can make the most of it. This is a huge challenge for the industry, and there is no doubt that there will be significant individual successes. However, industry wide success demands a big culture change. The question is: who is going to lead this?

A Vision for the Future

MIKE MURPHY
Innisfree, Rathpeacon, Co. Cork

Four key questions must be addressed:-

- *Has the dairy industry a vision for the future?* **No.**

2 *Is it critically important that the dairy industry has a clear vision for the future?* **Yes.**

- *Why?* **Otherwise 9 out of 10 dairy farmers will either be out of business or living in poverty within 10 years.**
- *What should happen now?* **The challenge to the industry is to develop a clear future vision and then make that vision happen.**

Success in life and in all business activity is based on:

⇨ excellent leaders, who

⇨ develop a clear future vision for their businesses, and

⇨ have a well thought-through strategic plan to turn that vision into reality.

What challenges do we now face?

After nearly 30 years of highly protected markets, the twin forces of WTO and EU enlargement are inevitably grinding towards a less protected and sheltered future.

Already globalisation of food companies has lead to a hugely competitive food market. The 20 largest food companies in the world 18 months ago have now reduced to 10 companies, either through a process of merger or acquisition. This change is leading to a level of competitive challenge, which is totally unprecedented. Irish dairy companies who have stood still in recent years have in practise lost ground. Standing still means going backwards fast in today's savagely competitive marketplace.

There is ever-increasing buying power of a highly concentrated retail sector. It is predicted that by 2005 the top 10 food retailers in the EU will control 90% of retail sales. Irish food firms will need reasonable scale to be able to fully service multinational retail chains, or multinational food service chains like MacDonald's. Scale and product differentiation will be necessary to counter the buying power of the huge retail chains. Grow or die!

Food scares in Europe (BSE and Foot and Mouth) have led directly to a 'greening' of EU agricultural policy. Policy makers who are imposing ever more bureaucratic and costly requirements on EU farmers are largely ignoring scientific fact. Our competitors outside the EU will not follow this policy.

An ageing dairy farming sector, where 92% of farmers are now over 36 years old, will find the challenge of adapting to a less protected era very difficult indeed. The need for energetic young blood is obvious. The farm organisations, especially the IFA, while hiding behind the coat tails of the Department of Agriculture have totally blocked any real opportunity for young people entering farming. The lack of longer term thinking by the farm organizations is a huge competitive disadvantage for the dairy sector.

A product mix that is still largely commodity dependent will be a major area of vulnerability for the future. Again the exceptionally short-term policies of the farm organizations are a major barrier to the necessary heavy investment in the key factors that drive long-term business success in the international marketplaces. My contention is that, in these areas the farm organizations are acting directly against the longer-term interests of farmers. The question has to be asked - are the farm organizations capable of taking a long-term strategic view? Farm organisations could learn from how institutions and analysts measure and assess public companies. Institutions expect to see a clear strategy from public companies. They then measure these companies on how successfully they implement their strategies over time. Are targets met? Reward or sanction is then based on measured performance. In order to secure future returns dairy farmers will need to invest more in their industry. This is not to endorse a blank cheque. Farmers will accept a lower milk price to support well thought through strategies, which will deliver better, or more secure, future returns. The plan must be 100% measurable with clear targets. Results will have to be delivered within an agreed time span. Everything should be geared to better returns to farmers over time, based on performance in the international marketplace.

We know from our political masters that farmers will receive a dairying premium – i.e. a cheque in the post of 9.2 p/gallon in 2007, in exchange for a milk price support cut of 17.1 pp/gallon. It is anticipated that in 2007 milk price plus premium will be about 8% lower than the current milk price. Higher inflation in Ireland (relative to the rest of EU), coupled with falling commodity prices, are at the moment leading to a deterioration in our trading terms of about 5% per annum in real terms. Increased efficiency can offset only part of this loss. Present official policy, which prevents the necessary up scaling to absorb the ensuing sharp yearly loss of income, isn't sustainable. It is gradually putting more and more farmers into a poverty trap. The need again for clear long term planning is very urgent. Without a clear vision for the future many of todays farmers will not be here in 7 - 10 years.

What of the future?

The challenges are formidable. The critical point is the lack of clear policy. We currently have no realistic vision for the future. There are some notable exceptions, but in the main we lack good leadership, which will face up to and overcome some very difficult challenges. The following illustrates what can happen when someone ignores major change. If you put a frog into a pot of boiling water, the scalded frog will quickly jump out and save himself. If however, the frog is put into a pot, which is gently heated, the frog won't fully realise the growing threat and will be boiled to death.

If we carry on as now, huge and traumatic change is inevitable, but if we have a real vision for the future - we can hop out of the pot quickly and shape an excellent future.

Two very relevant examples where good leadership and clear vision have dramatically turned things around are worth looking at to illustrate this point.

The Irish economic miracle

The Irish economy was badly mismanaged by all political parties from 1977 – 1986. We ran up sky-high debt, had crippling unemployment, rampant emigration, and high taxes. Many will remember the misery, doom and gloom of the period. In 1987 the 2 main political parties under Haughey, McSharry and Dukes came together via the 'Tallaght Strategy' and shaped a highly effective national vision of better prosperity and increased employment. All the main national partners bought into this vision. The result was the Irish economic miracle. Employment rose from 1.1 million to 1.7 million. Taxes were slashed, national debt as a percentage of GNP fell by two thirds. This was a triumph of clear vision, fashioned by good leadership, overcoming highly difficult circumstances.

The Kerry story

When a Tony O'Reilly led Dairy Board first branded Irish butter 35 years ago they chose the name "Kerry Gold" because Kerry was the one area in the country that everybody expected would never have a worthwhile dairy industry. It just wasn't conceivable. Impossible? Eddie Hayes, Frank Wall and a few other farmers with a vision, believed in the future and hired a 27-year-old kid called Denis Brosnan. Aided – not hindered by a major brucellosis problem that rocked Kerry in 1979 –1981, Kerry put in place a vision to become a world-class food and high added value differentiated ingredients business, a business, which would never again be dependent on commodity products, a business that created considerable wealth for Kerry farmers and shareholders. Today, Kerry is a world-leader in its field, and the Kerry success story is set to run and run.

What led to the success of Kerry and the Irish economy, and allowed each to overcome daunting challenges? The answer is crystal clear. Superb leadership and a clear vision for the future. Therefore the challenge to the Irish dairy industry today, must be to put into place a well thought through success plan for the future.

We have realistic grounds for optimism if we get our act into gear:

- We have a long grass growing season – a major competitive advantage if well utilised.
- Demand for milk worldwide is growing faster than milk supply. Meat proteins, hit by health concerns, are losing market share. This is allowing milk and soya proteins to grow quite strongly. Intervention stores in Europe are empty of dairy products; also cheese consumption in Europe is growing quickly.
- Milk has long been recognised for its superb functional characteristics but a most encouraging development has been the emerging evidence that the long medical campaign against dairy products is based on a false premise.
- Dairy products are good for your health. Milk has many healthy nutraceutical benefits. In particular, the high CLA content of grass-produced milk will lead to major opportunities for a pastoral dairying country like Ireland. However we must get the real facts out to consumers. This will take major resources, and after years of misinformation consumers will need to be retold repeatedly that milk is a wonderful product.

- We also have full access to a marketplace of 370 million affluent consumers.

So there are real opportunities in the marketplace, but only the swift and able will grasp these. Will we fully grasp these opportunities? Not with present policies. **We must change and change now.** We must develop a vision for the future, a vision that in 10 years time we have a positive, dynamic, growing Irish dairy industry which is highly competitive internationally at every level, and providing good incomes and careers to people at all levels of that industry. This contrasts with the doom and gloom of present predictions of only 10,000 milk suppliers in 10 years. If the appropriate policy changes are made now, then we can have 15,000 to 20,000 dairy farmers in 10 years time.

Some elements of necessary change

We have an over dependence on commodity milk products, and little progress has been made on this over the years. Why so? Are their success stories we can learn from?

The Danish Dairy Industry

Twelve years ago the Danes had a huge exposure to feta cheese – a commodity they sold largely in the Middle East. They then took a decision to invest substantially in growing their share of the European cheese market. Heavy sustained investments in product and market development have led to much lower commodity dependence today. Danish farmers thought of long term market success, agreed to take lower milk prices and are now much better strategically placed for a more secure future.

Kerry

In 1980/81 Kerry realised that selling via a broker, i.e. the Irish Dairy Board, would never quickly achieve a reduction in commodity dependence. So Kerry integrated production, marketing and R&D within Kerry. This was the key step in Kerry's present success. This demanded a huge commitment of very scarce resources for the then very small Kerry Co-operative. It had to be done if Kerry was to achieve real market power. Now Kerry has about 450 scientists, and a marketing strength far in excess of the Dairy Board.

[Note: None of the Irish co-ops who want to sell high value hi-tech food ingredients to the major food multinationals can hope to compete successfully operating through a broker like the Dairy Board, against fully integrated operations like Kerry Group. For this reason, the New Zealand Dairy Board – which has always been by far the most effective, centralised milk selling agent in the world has just integrated backwards with 98% of the NZ manufacturing industry].

Fully integrated dairy companies, which continually meet with their customers, are far more responsive to market signals. Trying to compete via a broker like the Irish Dairy Board is like trying to fight a boxing match with one arm tied behind your back. Going via a broker does not work. We have to change. Let's learn from Kerry Group. Their success is based on:

- Superb leadership
- Clear vision

- Fully integrated production, marketing and R&D, and a willingness to invest long term in the key drivers of their business i.e. highly skilled people, R&D, global reach, strong market positions in selected segments, well selected acquisitions to acquire key new technologies, key new customers, and enhance market share
- Scale. It is estimated that Kerry Group will have sales in 2002 of ≠3.8 billion. Yet Denis Brosnan believes that this is quite limiting and Kerry needs to have sales of above ≠5 billion within 2 or 3 years to remain competitive at world level!

To have a secure future we must set a goal of reducing commodity dependence by perhaps 3 to 4 % per annum. Thus the aim should be that in 5 years we would have approximately 20% more products sold in non-commodity form. To achieve this we will need:

- Clear vision over time
- Huge structural change which will give scale and also integration of production, marketing and R&D.
- Heavy investment in people, product, and market development. This investment will be for an agreed plan, which is measurable. Targets must be completely transparent and the executive management of dairy companies will be measured on performance relative to targets.

A failure to plan is a major limiting factor. *Failing to plan is planning to fail.*

At farm level, farmers and researchers will need to get together to tackle the following issues.

- *Low capital costs* - identify innovative ways of housing, feeding, milking cows and rearing calves etc at low cost. To grow the industry, the capital cost of expansion will have to be low. Can we identify a pathway to converting farms from non-dairy uses to dairying at a total infrastructure cost of £600 – 700/cow?
- *Low operational cost* - this has to be centred on maximum use of pasture. If we can regularly achieve milk solid outputs of 1100 – 1200 kg/ha on systems where +75% of a cows total dry matter intake is coming from grazed grass then we will be very competitive relative to all European countries. To achieve this we will need to have well researched systems where cows calve rapidly, and go directly onto pasture. This type of system reduces feed costs, labour, veterinary and capital costs.
- *Labour productivity* - we need systems that allow high productivity but are also people friendly. It's a big challenge. The present 'Labour Use Study' at Moorepark is an excellent example of how researchers and farmers need to work together harmoniously and respectfully, while also being open to robust and forceful debate and discussion.
- *Low wastage* - seasonal calving isn't sustainable with low fertility. We have major problems in this area, which must be quickly overcome. Good survivability and good fertility are critical success factors for our low cost pastoral based seasonal systems.

Excellent research focussing on low cost systems has been hugely valuable to farmers from the early days of Moorepark. However, my contention is that research work in most of the 90's focused excessively on achieving high production per cow, rather than achieving high profit under Irish conditions. The refocussing on high profit in recent years is welcome. Our competitive advantage lies in producing high quality milk cheaply from pasture, which has a 'clean, green image'. To this farmers must be prepared to fund good research. It is an investment that will give excellent returns. Every industry needs continuing well-focused innovation to stay competitive over time.

Extension and education must also face up to new challenges and realities. With the exception of some private companies, this is largely the remit of Teagasc. In relation to dairy farmers, there is a perception that the service offered is not relevant to their needs, and that some advisors have little understanding of what profit and return on investment is really about. Some farmers have been encouraged to spend large amounts of money in hopelessly low return areas. These issues must be addressed at the earliest possible opportunity. It is suggested that Teagasc needs to give priority to increasing farmers incomes and net worth, and that some degree of performance measurement would go a long way to restoring confidence in the service offered.

The challenge for management to turn things around. Clear and measurable goals are required, with the objective of putting more money in farmers' pockets. There is a need to adequately reward those advisors that successfully deliver on these goals. The Irish dairy industry cannot progress and compete in the international arena without access to a technically competent, well funded extension and education service.

In Summary

At present there is lack of clear vision (arguably no vision at all?) A clear vision for the industry is urgently required in order to secure a prosperous farming future for a large number of Irish dairy farmers. Real changes (not cosmetic changes) have to be made now – today for future success. The challenge to all segments of the industry is to come together to agree and secure a vision for the future. If we respond strongly to the challenge then present difficulties will be overcome, and we can develop a vibrant industry, which will provide opportunity, prosperity and a good future for Irish dairy farmers!

NOTES

NOTES

NOTES

NOTES

NOTES

NOTES