National Dairy Conference 1999

Dairying

in the

New Millennium

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Challenges for Dairy Farmers in the New Millennium

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Irish dairy farmers can face the new millennium with optimism. A reasonable milk price has been secured by the Agenda 2000 agreement, which will underpin dairying up to the year 2008. Few others in the self-employed sector can hope to operate in a framework of such certainty for a period of this duration.

Nevertheless, within this new Policy Framework there will be some downward pressure on milk price and future W.T.O. rounds are likely to continue the trend towards world market price - all be it with partial compensation payments to aid the transition.

Over the next decade then the challenge facing dairy farmers will be to maintain/increase farm profits in real terms, while working to more exacting milk quality and environmental standards. This is not a new phenomenon. Dairy farmers have faced all of these pressures in one form or another right through this century. The net result has been a high attrition rate with the number of dairy farmers declining from 86,000 in 1980 to 31,000 currently.

This challenge is not an un-surmountable one, and neither is it unique to dairy farming. Every manufacturing industry, big and small, faces the same challenge on a daily basis. Indeed most operate in a much more volatile environment than dairy farming within the CAP regime.

Over the next decade, I believe dairy farmers who strive to adopt new practices and keep a firm focus on maximising farm profit, will have no difficulty in meeting this challenge.

In the remainder of this paper I will focus on some aspects of this challenge, which are under your control, under the following headings.

- Increasing Farm Profit
  - Technical Efficiency
  - Scale
  - Labour / Work organisation.
  - Education

- Meeting higher food quality standards

- Protecting the environment.

Technical Efficiency

Meeting the challenge of maintaining/increasing farm profit in real terms in an era of falling milk price means production costs have to be lowered. Reducing production costs must be a central focus for every dairy farmer. Within Teagasc, we have set a clear target that creamery milk producers should have common costs of less than 40p/gal. National Farm Survey data indicates that average common cost is around 49/gal. Best performing Teagasc clients are producing spring milk at a common cost of 25-30p/gal and liquid milk at 30 - 35p/gal.

The steps in reducing costs are:-

1. Completing a Dairy Profit Monitor to establish farm cost structure.

2. Evaluating costs under all headings looking for potential savings.

3. Preparing a financial plan and evaluation of future spending on capital items.

4. Improving grassland management skills through participation in a discussion group. Optimising grass intake is the key to maximising profit.

Common costs for spring milk production for a sample of 43 master farmers are presented in Table 1 (Ref. - Matt Ryan Teagasc).

Table 1 - Common Costs p/gal for Master Farms '98 - Spring Milk.

Meal	7.2
Fertilizer	5.1
Vet & A.I.	4.3
Contractor	3.1
Other V. Costs	3.1
Common F. Costs	13.7
Total	**36.6**

Common costs exclude interest, lease and labour. Hired labour cost per gallon was 4.6p/gal for Spring milk producers and 4.8p/gal for Winter milk producers. The range in common costs in this sample are presented in Table 2.

Table 2 Range in Common Costs (p/gal)

	Spring Milk	**Winter Milk**
Highest Profit Farmers	23.3	32.7
Lowest Profit Farmers	48.9	43.1
Difference / Range	25.6	10.4

What conclusions should you draw from these figures? Based on these figures, many dairy farmers have the opportunity to cut costs by 10p/gal. If this is combined with another 5p potential gain through protein improvement than returns from a 50,000 gal quota could potentially be improved by £7,500 on many farms.

Scale of Operation

When discussing the challenge of increasing dairy profits the topic of scale of operation inevitably arises. The usual questions are, how much quota is required for a dairy farmer to survive today and what will he require in future?

Table 3 - Number of Producers by Quota Size (Dept. of Agric., 1996 and 1999*)

Quota Size (gallons)	**No. of producers 1996**	**No. of producers 1999**	**% of Total Producers 1996**	**% of Total Producers 1999**
< 20,000	16,207	10,758	44%	34%
20,000-35,000	10,344	9,819	28%	31%
35,000-55,000	6,053	6,523	17%	21%
Over 55,000	4,145	4,304	11%	14%
Total	36,749	31,404	100%	100%

** ('99 figures are provisional only)*

The answer to these questions depends on the expectations of the farmer. Taking the average industrial wage as a starting point (£18,089) we can say that currently this roughly equates to a 30,000 gal. quota farm. However, this does not take into account that many households are now two income households. Thus if the expectations of a household are to generate an income from dairying equivalent to a two income household then we are talking of a 60,000 gal quota.

Dairy farmers views on quota size for farm viability were obtained in a University of Limerick study (Ref. - Analysis of the Dairy Sector in Limerick - University of Limerick). This study showed most considered that a viable quota was 40-60,000 currently but that this would move to 60-80,000 in future. When estimating future quota required to generate the average industrial wage, we must taken into account the likely increase in the average industrial wage, the reduction in milk price / compensation and future productivity increases. In the period to 2008, I believe there is scope for dairy farmers to cancel the price reduction effects through reducing production costs. However by 2008 the average industrial wage is likely to be 1/3 higher than it is today. Thus I believe dairy farmers will have to increase scale by 1/3 over the next 8 years to sustain their position i.e. the 30,000 and 60,000 gal. quotas will need to increase to 40 and 80,000 gals respectively. If quotas were abolished without compensation after 2007 a quota of 70,000 gals.+ will be needed to give one average industrial wage.

Against a background of gradual change in EU policy the implications of these calculations are that dairy farmers must be allowed grow quota size by at least one-third. If on the other hand quota abolition follows quickly after 2007 then dairy farmers will need to target a doubling of quota size. The more we move towards unprotected / unsubsidised dairying, the more both scale and efficiency become essential.

Changes in EU quota policy and the rate of same will have to be anticipated by national governments so that appropriate restructuring can be carried out over a number of years. Teagasc believes there is a strong case for identifying a core of 5000 small to medium sized producers who would work to a planned development programme involving the acquisition of additional 20,000 gals quota over the duration of the new quota regime to 2007. Minister Walsh's recent announcements on quota allocation could form the foundation of such a development package.

Proposed changes in quota policy for Ireland will have the effect of transferring ownership of quota from 'sofa producers' to active producers. This I believe will give active producers a stronger and more definite base as we move into the new millennium. Proposed changes include time limits on temporary leasing, ending commercial leasing and transfer of quota to active producers through a new Restructuring Scheme. As well as purchase of quota through the new Restructuring Scheme there is also likely to be a provision for existing leases to be bought out at Restructuring Scheme price.

Table 4 shows the present value of the after tax cost of quota purchase and quota lease. If we assume we will have quotas for another 10 years then quota purchase at £1.50/gal is cheaper in all cases than leasing at 30 or 40p/gal. In many farm situations land taken with quota does not cover its cost. If this were added into the equation, then leasing would be more expensive again than shown in this table.

Table 4 Present Value (£) of Quota after Tax Cost/Gal.*

Option		Zero Tax Rate	24% Tax Rate	46% Tax Rate
Purchase @ £1.50 over	7 yrs.@ 6% p.a.	1.75	1.67	1.60
Lease @ 40p for	7 yrs.	2.64	2.01	1.37
	10 yrs.	3.77	2.86	1.96
	20 yrs.	7.54	5.73	3.92
Lease @ 30p for	7 yrs.	1.98	1.50	1.07
	10 yrs.	2.83	2.15	1.52
	20 yrs.	5.66	4.30	3.05

** Discount Rate 6%. PRSI & levies not allowed for in calculations*

In conclusion, I believe the challenge facing both policy maker and individual farmer is to achieve an increase in scale of quota size by at least one third in the period covered by Agenda 2000.

Farm Labour / Work Organisation

Serious challenges now face Irish dairy farming on the labour front. In a Co. Meath study (Ref - Meaths Farming Future - Leader II Study) , almost half the farmers over 50 years of age had not identified a successor and 41% of those saw serious difficulties in doing so. For this group the main reasons given were children's lack of interest (46%). Unsociable hours were identified by 26% of respondents as a primary factor discouraging young people from entering farming as a career. This figure relates to all enterprises and is likely to be much higher for dairying.

Serious problems also exist with regard to hired labour. In the same Co. Meath study 46% of farmers hired labour of some description. Approx. 20% of survey respondents recorded a reduction in hired labour over the last five years. Employees leaving was cited as the biggest factor.

Unless the problems of labour and work organisation are seriously addressed on Irish dairy farms, serious damage will be inflicted on morale. Possible solutions include:

1. Higher wages - only large dairy farms with good working conditions are likely to be able to compete with other sectors for scarce labour.

2. Better Facilities, Better Work Organisations, Higher Labour Productivity.
   Improvements in farm layout can lead to drastic reductions in labour requirements, as can improvements in work organisation. These topics will be discussed in more detail in another paper.

3. Partnership farming can make a huge contribution in this area. Without doubt the most satisfied, most optimistic and the most expansionary-minded farmers I have met in recent times were those I met working in partnership arrangements in Denmark and France. On a recent trip to Denmark, I was pleasantly surprised to meet one of 3 partners in a 250 cow operation + pigs and tillage at 10.00 a.m. on a Saturday morning in his best clothes and just out of bed. I was informed that this was his weekend off!

Partnership farming means every second weekend off, cover for sickness and annual holidays combined with an improved capacity to expand the business through economics of scale and better labour efficiency. Contrast this with situations on Irish dairy farms where a bout of flu could result in the disposal of an otherwise profitable herd.

In simple terms, partnership farming means two or more farmers amalgamating their businesses into one, with each preserving right of land and capital ownership. Ideal examples in Ireland would be drystock farmers joining with dairy farmers or two dairy farmers coming together to milk two herds of cows in one set of housing and milking facilities. Profits can be shared based on capital and labour inputs.

I believe partnerships can make dairy farming attractive once more, as a career for young persons. There is an alternative to the seven-day week approach, and I believe parents who would like a successor to take over in the next millennium, should move to set up such arrangements. Dairying can become a 5-day a week job, the choice is yours. Should you pass on this option, don't be surprised if your successor states he is not interested in taking over because of unsociable hours!

Education
It is widely accepted that Ireland's education system has been one of the major foundation stones of the Celtic Tiger economy. During the 20th Century the old adage that 'knowledge is power' became more and more apt with each passing year. Successful dairy farmers of 21st Century will be those who accumulate new knowledge and new skills which enable them to respond to change and make informed decisions. A strong foundation in dairying and periodic updating courses, which will deal with new technologies, will be essential for successful dairy farming.

To help meet this challenge Teagasc has put in place new Diploma in Dairying Courses at Clonakilty and Multyfarnham Colleges. These courses will provide more specialised and intensive training for the dairy farmers of the future than the Green Cert. The Diploma course should, I believe in future be seen as the basic requirement for entry to dairy farming.

With regard to future developments, Teagasc is currently planning joint courses with various Institutes of Technology. These will bring agricultural education within the CAO system and open up new opportunities as well as allowing students to progress qualifications to degree level.

As a follow on to basic courses, Teagasc has in recent years also commenced Advanced Certificate in Dairy Herd Management courses at various centres throughout the country. These courses are aimed at dairy farmers in their mid 20's to early 40's who have a basic qualification. They focus on updating farmers in the latest technology and practical day to day management. Courses have been very favourably received by participants to date.

Finally I believe participation in a discussion Group will have a very important role in the continuing education of adult farmers. Participation in groups is possible throughout the country as Teagasc has almost 250 Dairy Discussion Groups nationally, many as part of joint Industry/Teagasc Programmes.

Meeting Higher Quality Standards
As with the challenge of increasing farm profit, the challenge of meeting higher quality standards has been with us for a long time now.

We have moved from quality tests involving smelling the milk, to methylene blue, to TBC and TBC standards have become increasingly more demanding. In recent years we have seen the introduction of SCC counts and liquid suppliers have had to deal with Temoduric counts, sediment and lactose to protein ratio tests.

While new standards will be seen as demanding at the time of introduction, history has shown that new knowledge and new techniques can quickly be used to allow producers easily meet such standards. The fact that nobody dies or gets sick as a result of the present hygiene quality of dairy products, is not an argument for leaving well enough alone. Many aspects of future quality requirements will be more related to marketing requirements than to anything else. Put simply we must keep pace with our competitors in meeting customer requirements.

Future quality standards will have one or both of the following objectives:

1. Measurement of processing quality, for specific products.
2. Assuring customers regarding dairy products.

Tests in the first category will attempt to measure suitability of different milks for making particular product such as cheese, cream liqueurs etc. In the second category, customer assurance will lead to increasing demands with regard to management practices by the multiples. These now control 60 - 70% of the retail market in many countries. Complying with such standards will be necessary if we are to protect our markets and attempt to access new ones. All embracing codes of practice involving all elements of hygiene, nutrition, environment, animal welfare etc. have already been imposed on UK suppliers by the multiples.

I believe Irish suppliers should be proactive and seek to work to a common Code of Practice, which would be acceptable to the multiples. To this end, Teagasc in conjunction with other interested parties is in the process of compiling such a code. This code will mirror that used in pig production currently. I believe a proactive approach involving the adoption of such a Code would make life a lot easier for dairy farmers of the future.

Protecting the Environment

The final challenge I want to mention is that of environmental protection. Fortunately any conflicts that might exist between intensive dairy farming and environmental protection can be minimised through good husbandry practices. These practices and Codes of Practice have been well documented and widely circulated. The challenge for sustainable dairying is that these Codes of Practice are implemented fully by all dairy farmers in the immediate future.

Some of these practices such as proper use of slurry and fertilizers can save farmers money. On the other hand improving slurry and effluent storage facilities is likely to cost some dairy farmers considerable money.

Better slurry storage, prevention of effluent run-off, concentrating slurry spreading in Spring and Summer periods and adherence to Teagasc P recommendations will ensure farming does not contribute to phosphorus build up in lakes and rivers.

Ensuring that nitrate levels in groundwater do not breech EU guidelines is another concern that some dairy farmers will have to face in the new millennium. In free draining nitrate sensitive areas, measures such as ensuring all tillage fields have a green cover in winter, refraining from nitrogen application in periods of low or no growth and restricting nitrogen application to Teagasc guidelines will help minimise problems.

While Ireland is in a totally different situation to Holland and Denmark with regard to its environment, failure to implement the above guidelines will lead to similar regulations being put in place in certain sensitive Irish environments. In Denmark nine months slurry storage is required and stocking rate is restricted to two cows per hectare. In addition a serious penalty is charged for excessive nitrogen applications.

Conclusion

We are moving into the next millennium with a favourable policy framework for dairying. Through application of best technology, dairy farmers can maintain / increase incomes well into the next decade.

The attitude of potential new entrants to dairying is not what it should be currently. This is largely due to the unsociable hours currently worked and also a belief that incomes are low in farming.

Partnerships are a solution to un-sociable hours and must be adopted in Irish dairying rapidly. The perception that incomes are low is false on most Irish dairy farms. Dairy farmers must inform potential successors of the income and financial situation on their farms as otherwise they are contributing to the poor perception of dairying.

In efficiency and scale terms, dairy farmers must bring down common cost of production and a increase scale by one third in the period to 2008.

Breeding the Dairy Cow of the Future
Today's Challenges

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Abstract

The reproductive performance of Irish dairy herds is comparable to that of other pasture-based dairy systems worldwide. Temporal trends in Irish data show a decline in calving rate but an improved calving pattern at the expense of increased culling for 'infertility'. A negative association was found between milk yield and fertility in Irish dairy herds. The economic advantages of compact calving close to turnout are outlined. The need to reconsider the continued use of traditional indices of herd reproductive performance in seasonal breeding systems is presented. The greatest potential impact of advances in breeding over the next decade is likely to be the incorporation of fertility traits into a genetic selection index. The current focus of the Teagasc dairy cattle reproduction research programme is on the interactions between genetics, nutrition, milk yield and fertility, with emphasis on embryo development and mortality.

Introduction

The current international concern about the fertility of high producing dairy cows (Diskin et al., 1999) has highlighted the challenges facing farmers, breeding organisations and animal scientists in breeding the dairy cow of the future. These challenges centre on the negative association that exists between milk production and most fertility traits (Grosshans et al., 1997). However, this is not the only constraint to breeding the dairy cow of the future. Research results both nationally and internationally show a temporal decline in dairy cow reproductive performance. Whilst increasing milk volume and solids output have been associated with this decline, other management factors have been identified which contribute to lower calving rates (O'Farrell and Crilly, 1998).

Recent research work at Moorepark (Snijders et al., 1999) suggests that farmers and scientists in each country need to evaluate the types of dairy cow best suited to their specific management systems. Towards this end, Teagasc Moorepark and Athenry have initiated collaborative research programmes to define and address the factors that reduce reproductive efficiency both now and for the dairy cow of the future.

The objective of this paper is to detail the challenges facing farmers breeding dairy cows in the next millennium and to outline how the Teagasc dairy cattle reproduction research programme is addressing these challenges.

This paper is laid out in seven sections:

1. Current reproductive performance internationally
2. Temporal trends in reproductive performance
3. Effect of milk yield on reproductive performance
4. Economic costs of poor fertility
5. Constraints to compact calving
6. Potential impact of advanced reproductive technologies
7. Teagasc dairy cattle reproduction research programme

How do we compare internationally?

National benchmarking for reproductive performance is assuming greater importance with the widespread introduction of genes from year-round; non-pasture based production systems into seasonal, pasture-based systems. The main differences between these systems in herd size, milk yield/cow and reproductive performance are shown in Table 1. Irish data are from the Teagasc DairyMIS management information system (Crosse, 1985). Given these differences in management systems, valid comparisons with Irish seasonal calving herds can only be made with other seasonal, pasture-based systems such as those in New Zealand and Australia.

Differences in the definitions used to describe performance indices must be recognised when comparing databases. Furthermore, our traditional descriptors and targets for herd reproductive performance, such as inter-calving interval, need to be supplemented with some measure of the compactness of the breeding season, such as number of cows pregnant within six weeks of the start of the breeding season.

Table 1 : Dairy herd characteristics and reproductive performance in Australia, Ireland (spring and autumn), New Zealand, North America and the United Kingdom.

Index	Target	Australia	California	Ireland		New Zealand	UK
				Spring	Autumn		
No. of Herds	-	128	594	175[1]	69[1]	300	90
Seasonal	-	yes	no	yes	yes	yes	no
Herd Size	-	185	650	99	149	220	152
Yield (kg) 5000	-	5700	9235	5170	5345	3600	
Heat Detection Rate (%)	>90	75	45	na	na	90	56
Submission Rate (%)	>90	77	na	88	67	79	55[2]
Calving to 1st Service							
(days)	<60	58	81	73	78	na	69
Calving to Conception							
(days)	<80	100	141	na	na	na	100
1st Service Conception							
Rate (%)	>60	49	23	56[3]	56[3]	56	47
Serves per Conception	<1.4	na	2.6	1.7	1.8	1.8	2.1
6 week Pregnancy							
Rate (%)	>87	63	na	na	na	77[4]	na
Pregnant by 100 days							
Postpartum (%)	na	53	32	na	na	na	na
Infertile Rate (%)	<5	9	31	11	12	8	10
Induced (%)	0	15	na	na	na	6	na
Calving Interval (days)	$\leq$365	na	426	373	382	na	380
Culling rate (%)	<20	na	38	21	21	20	22

na = not available

[1] = herd-years, [2] = 24 day S.R., [3] = calving rate, [4] = 45 day PR

The submission rates in the Irish DairyMIS data (% cows calved $\geq$ 21 days at the start of the breeding season served within the next 21 days) are similar to those achieved in New Zealand and Australia, but lower in autumn than in spring calving herds. Whereas traditionally the target first service conception rate was > 60%, these data suggest this is no longer being achieved internationally and calving rates are now closer to 55%.

Temporal trends in reproductive performance.

Temporal trends in Irish dairy herd fertility and yield over the eight year period 1991-1998 were assessed using a subset of the DairyMIS herds (Table 2). This subset comprised 175 herd-years of data from 32 spring calving herds – defined as those with 85% of cows calving between January and June. Herds which were not continuously present in the management system for at least 7 of the 8 years were excluded as were those with incomplete records – defined as more than 10 percent of cows calving to unrecorded services.

Table 2 : Temporal trends in reproductive performance, milk yield and cow age between 1991 and 1998 in spring-calving Irish dairy herds.

Year	Submission Rate[1]	Percent of bred cows not recalving	Calving Rate		Percent of herd calving 1st Feb- 31st March			Average yield (kg.)	Mean age (lactations)
			1st serve	Overall	All	Heifers	Cows		
1991	84.4	7.3	59.0	58.4	53.2	68.1	50.6	4699	4.32
1992	86.6	6.7	59.8	59.4	53.7	70.1	50.1	4720	4.32
1993	83.9	7.2	59.2	60.0	54.9	64.0	51.8	5119	4.05
1994	91.0	8.7	53.2	56.4	58.5	64.1	57.7	5091	4.08
1995	90.4	6.2	58.3	60.9	63.5	71.7	61.3	5304	3.85
1996	89.8	10.8	54.7	59.1	58.7	61.8	58.1	5407	3.72
1997	86.4	13.5	53.8	56.1	68.5	68.4	69.3	5448	3.47
1998	90.4	- 2	54.1	55.2	66.8	68.5	66.5	5359	3.45

[1] *Percent of cows calved $\geq$ 21 days at the start of the breeding season which were served within the next 21 days.*

[2] *Figures comparable to previous years not available for 1998.*

There was a significant decline in calving rate to first service between 1991 and 1998 of the order of 0.9% per annum. The decline in overall calving rate was smaller (0.5% per annum), and of borderline statistical significance. Despite this decline in fertility, the herds improved their calving pattern with a highly significant increase in the proportion of cows calving between 1st February and 31st March. The calving pattern for the heifers, however, did not change significantly over time. In order to achieve a compact calving pattern despite a falling conception rate, an increasing proportion of cows that had been bred were subsequently culled. This is sometimes called an infertility rate but is in fact a management practice used to maintain a seasonal calving pattern. The costs associated with such an increased replacement rate are discussed below.

Average milk yield in the study population increased significantly at a rate of 108 kg per annum while the mean herd age fell by 0.14 lactations per year, again highly significant. Submission rates increased slightly over the study period at a rate of 0.6% per annum but this increase was of borderline statistical significance.

Effect of milk yield on reproductive performance.

Numerous international studies suggest that high yielding herds generally have lower conception rates. However, a recent large scale study in Australia did not find a similar relationship between high and low yielding cows within individual herds (Morton, 1999a).

The association between milk yield and fertility in Irish herds was investigated using the full DairyMIS dataset of 237 herd-years, containing both spring and autumn calving herds. Herds with incomplete records, i.e. those with more than 10 percent of cows calving to unrecorded services, were again excluded from the analysis. An analysis of variance model using mean herd yield as the predictor showed a highly significant negative correlation between milk yield and calving rate to first service. Each increase in yield of 100kg was associated with a decline in calving rate of 0.47%. Despite the strength of the statistical association, fertility levels varied widely between herds and milk yield accounted for only 5.6% of the overall variability in first service calving rate.

The association between yield and fertility in the DairyMIS herds was compared with the results of a study carried out by Nebel and McGilliard (1993) in dairy herds in North Carolina. In the American study, a negative association was again recorded between fertility (in this case defined as conception rate to first A.I.) and yield across a range of milk yields from 6,500-10,500 kg. An analysis of variance model using the figures reported by the authors indicated a decline in fertility of 0.34% per 100kg increase in yield. When the data from the two studies are combined in a single graph (Figure 1), it is evident that both are recording the same phenomenon, occurring at a range of milk yields from 3,500 to 10,500 kg. The DairyMIS data are displayed as a scatterplot of calving rate to first service against mean herd milk yield, each point representing a single herd-year of data. The US data show the first service conception rates for 1,837 herds divided into 5 groups according to yield.

These results have substantial implications for future breeding policies in the Irish dairy industry. Unpublished data show that the rate of increase in the RBI of sires used in the national dairy herd has decreased in the last three years.

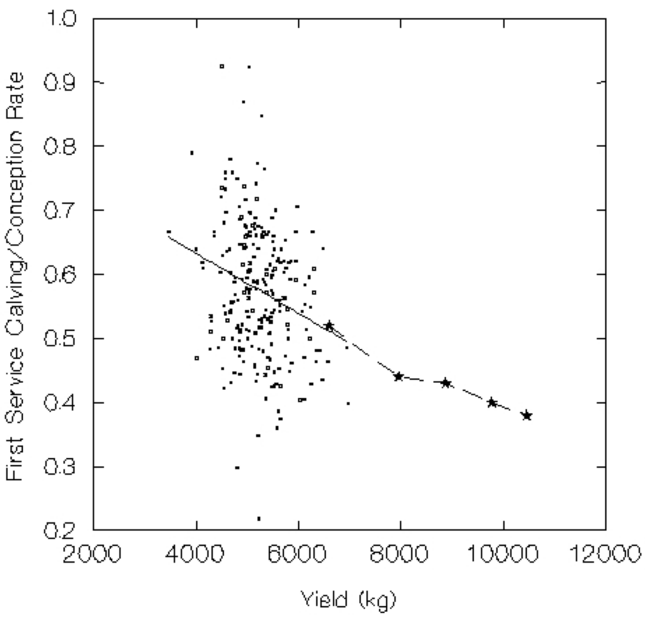

Figure 1. : Relationships between milk yield and fertility in Irish and North American herds. DairyMIS data = scatter plot with fitted linear regression line, U.S. data = with dashed line.

Economic costs of poor fertility

Previous studies at Moorepark have demonstrated the economic advantages of a compact calving pattern which allows up to eighty per cent of milk to be produced from grazed grass (Dillon, 1996). For spring-calvers this means the planned start of calving should be four weeks prior to the predicted turnout date to grass. Even within herds calving compactly, recent economic analyses have shown the benefits of cows becoming pregnant in the first three weeks of the breeding season compared to the second three weeks (Morton, 1999b). In an economic analysis of the impact of different Holstein-Friesian genotypes, Dillon and Buckley (1999) showed that the highest margin/cow was achieved with medium genetic merit animals. In this herd, the reduction in yield in the medium merit cows was more than offset by savings due to lower infertile and replacement rates. However, depending on the relative reduction in fertility of the high merit cows, a similar result could not be expected in every case. In the DairyMIS dataset for example, there is no association between calving rates and profitability as measured by margins over feed and fertiliser costs. A recent analysis of the effect of varying replacement rates on margin/gallon showed a 10% difference in replacement rate resulted in approximately a 5p difference in margin/gallon in a milk quota environment (Table 3).

Table 3 : Effect of varying replacement rates on margin/gallon for varying levels of replacement heifer costs and cull cow values.

Replacement rate (%)	Cull cow value (£)	Replacement cost (£)	
		900	**1,100**
15	**300**	60.0	57.6
	400	61.3	58.9
20	**300**	57.7	54.4
	400	59.4	56.1
25	**300**	55.3	51.2
	400	57.4	53.4

Source : Crosse, S. (1999).

In the UK, the average economic cost of poor fertility, including increased culling, is estimated at £9,600 per 100 cows with the worst quartile of herds losing £17,700 per 100 cows (Kossaibiati and Esslemont, 1995). More recently the cost of a delay in conception beyond 85 days has been calculated at £2-4/day depending on the extent of the delay and milk yield (Esslemont and Kossiabati, 1999). The economic costs associated with an extended calving interval include lower annual milk yields, fewer calves, more services, extra veterinary costs and a slip from the profitable months of calving. These costings have recently been questioned with similar reproductive performance reported in cows on annual and extended lactation cycles (Knight and Sorensen, 1998).

In New Zealand the case for cost-effective use of hormonal treatments for anoestrus has been presented (Deadman, 1997) and in the UK a £3:1 return on preventive veterinary routines for infertility has been found (Esslemont, BSAS Meeting, Galway, 1999). While the advantages of compact calving are accepted in Ireland, similar appraisals of the economic benefits of fertility interventions have yet to be conducted.

Constraints to compact calving

A compact spring calving pattern can be defined as 90% of the herd calving in February and March with the remainder in early April. In reality, most Irish creamery milk herds calve over a five-month period between January and June. Autumn-spring calving herds can ‘roll over’ cows from one calving season to the next to compensate for a lack of compactness in the breeding season. However, in specialised autumn calving herds compact calving is of vital importance. The previous calving pattern, breeding policy for replacement heifers, culling strategy, stock purchases and reproductive performance dictate the calving pattern of a dairy herd. A seasonal, pasture-based dairying system dictates that cows should have an average interval of 365 days between consecutive calvings. This leaves 85 days to get the cow pregnant, assuming a gestation of 280 days. The two most important constraints on achieving an optimal calving pattern are poor oestrous detection and low calving rates.

In the U.S. oestrous detection efficiency has declined in recent years as herd size and milk production have increased (Stevenson, 1999). This has serious implications for the Irish dairy industry where future herds are likely to be bigger, milk production per cow will be increased and labour units per cow reduced. Previous Moorepark studies have shown that the duration of oestrus was approximately 9 hours (O’Farrell, 1992). Recent research reports have estimated the duration of oestrus behaviour in lactating dairy cows to be shorter, averaging 7.1 hours (Dransfield et al., 1998) and the length of the oestrus cycle to be increasing, from 20 to 22 days. Although the reason for the apparent reduction in the duration of oestrus behaviour is unknown, it may be negatively correlated with milk production (Harrison et al., 1990). Oestrous detection in the pre-breeding period is an important tool in identifying non-cycling or anoestrous cows that will reduce overall submission rates.

In a recent Moorepark study comparing cows with high and medium genetic merit, those with high merit were shown to have regular waves of follicular activity and normal signs of oestrus (Snijders et al., 1998). However, the high merit cows also had lower conception rates. Thus, over a breeding season of fixed duration (13 weeks), a larger proportion was culled as infertile (Snijders et al., 1999). Subsequent studies showed that the in vitro development of oocytes from high genetic merit cows was lower than that of medium genetic merit cows (Snijders et al., 2000).

Although return to cyclicity and ovulation occurs in most cows by 3-4 weeks post partum, optimum fertility is not achieved until 90-100 days post partum. The more cycles a cow has after calving, the higher the chances for pregnancy to first insemination (Thatcher, 1973). The optimal voluntary waiting period is around 60 days which gives sufficient time for the uterus to return to normality and allows 2 to 3 cycles prior to breeding. Currently there is debate as to the possible detrimental effects of an early resumption of ovarian activity post-partum on uterine involution and subsequent conception.

The effect of male fertility on calving rate can be mediated through sire fertility, semen processing and handling or AI technique. Non-return rates for individual bulls are published in some countries (Esslemont, BSAS Meeting, Galway, 1999) and can vary by up to 20% between bulls. In Ireland DIY insemination has become increasingly popular (O’Farrell and Crilly, 1998). It offers some advantages to farmers in terms of reduced costs, better timing of AI and potentially reduced stress on the animal. However, DIY AI depends critically on good technique. The relationship between success and the number of training days spent in the abattoir with access to live cows is highly significant (Howells et al., 1999). Farmers using DIY AI are more likely to have larger, higher yielding and autumn calving herds, all of which are negatively associated with calving rate (Table 4). When these effects are controlled for, the observed difference in calving rate to first service between DIY and commercial AI herds falls from 5.0% to 1.6% and is no longer statistically significant.

Table 4 : Characteristics of herds using predominantly commercial or DIY AI.

Herd characteristics	Insemination Type	
	Commercial	DIY
Herd size (No.)	92	131
Yield (kg)	5035	5381
Cows calving Oct-Dec (%)	3.0	13.8
Concentrates fed per cow (kg)	598	790
Milk price (p/gal)	100.9	103.7
1st service calving rate (%)	60.6	55.3

Embryonic loss is a significant cause of lower calving rates. The documented incidence of fertilization failure is low at 10 to15% but the incidence of total embryonic mortality is high at 38% (Sreenan and Diskin, 1986). In U.S. studies the incidence of embryonic mortality between 28 and 56 days of gestation was approximately 15% (Vasconcelos et al., 1997; Fricke et al., 1998). However, preliminary results from an on-going Teagasc study indicate that the incidence of embryonic mortality between 28 and 84 days of gestation in Irish dairy cows is lower (8%) than that reported in the U.S. studies. Furthermore, in the Teagasc study, the incidence of late embryonic mortality does not appear to be affected by milk yield and in fact was similar between heifers and cows. However, there may be a high incidence of early embryonic mortality in high yielding dairy cows (Sreenan and Silke, 2000).

Potential impact of advanced reproductive technologies

Novel embryo-based biotechnologies, such as transvaginal ovum pick-up (OPU) and in vitro production (IVP) of embryos and cloning, offer the prospect to revolutionise the dairy industry of the next millennium. However, relatively few of the new reproductive technologies will have national impact within the next decade. Advances in reproductive knowledge and technology likely to have national impact include incorporation of fertility traits in a selection index, benchmarking of the reproductive performance of the national herd and routine reproductive ultrasonography.

A large-scale study commenced recently in Teagasc, with national and international collaborators, to determine the associations between pedigree index, phenotypic traits and reproductive performance in daughters of Holstein-Friesian sires and hence contribute to the development of an improved genetic index. The data collected from commercial dairy herds will also be used to benchmark national reproductive performance and can be used in future modelling of herd reproductive performance as a component of the whole farm system.

Ultrasonography may be used increasingly as the skill level of operators improves and the costs decrease. In addition to trans-rectal and trans-abdominal pregnancy diagnosis, extender based trans-rectal pregnancy diagnosis and dating, foetal sexing, prediction of embryo mortality, determination of the stage of cyclicity or non-cyclicity, assessment of uterine pathology and OPU may be more widely practised. New developments in technology such as three-dimensional ultrasonography, head mounted VDU scanners and quantitative echotexture analysis may extend the impact of this technology.

Other new reproductive technologies, which are currently developed but not widely used, include semen encapsulation to allow longer life, ultra rapid embryo vitrification using the open pulled straw (OPS) technique, embryo and semen sexing, electronic oestrus detection and early conception factor pregnancy diagnosis. Some reproductive technologies, such as premature induction of calving and whole herd oestrus synchronisation and resynchronisation, may be more applicable in certain management systems than others.

Breeding the diary cow of the future

Teagasc dairy cattle reproduction research programme
Teagasc, in collaboration with other national and international institutes and universities, has an active, innovative research programme addressing the challenges faced by farmers in breeding the dairy cow of the future (Figure 2). The three major axes of this programme are the inter-relationships between genetics, nutrition, milk yield and fertility.

The genetic aspects of this program are focussed on the effects of sire, breed, cross breeding, RBI and origin of genotype on cattle fertility. The nutritional aspects of the program are addressing the effects of dietary energy, protein and fat on cattle fertility. Basic research on embryonic development and the timing and extent of embryonic mortality is being conducted in conjunction with these studies.

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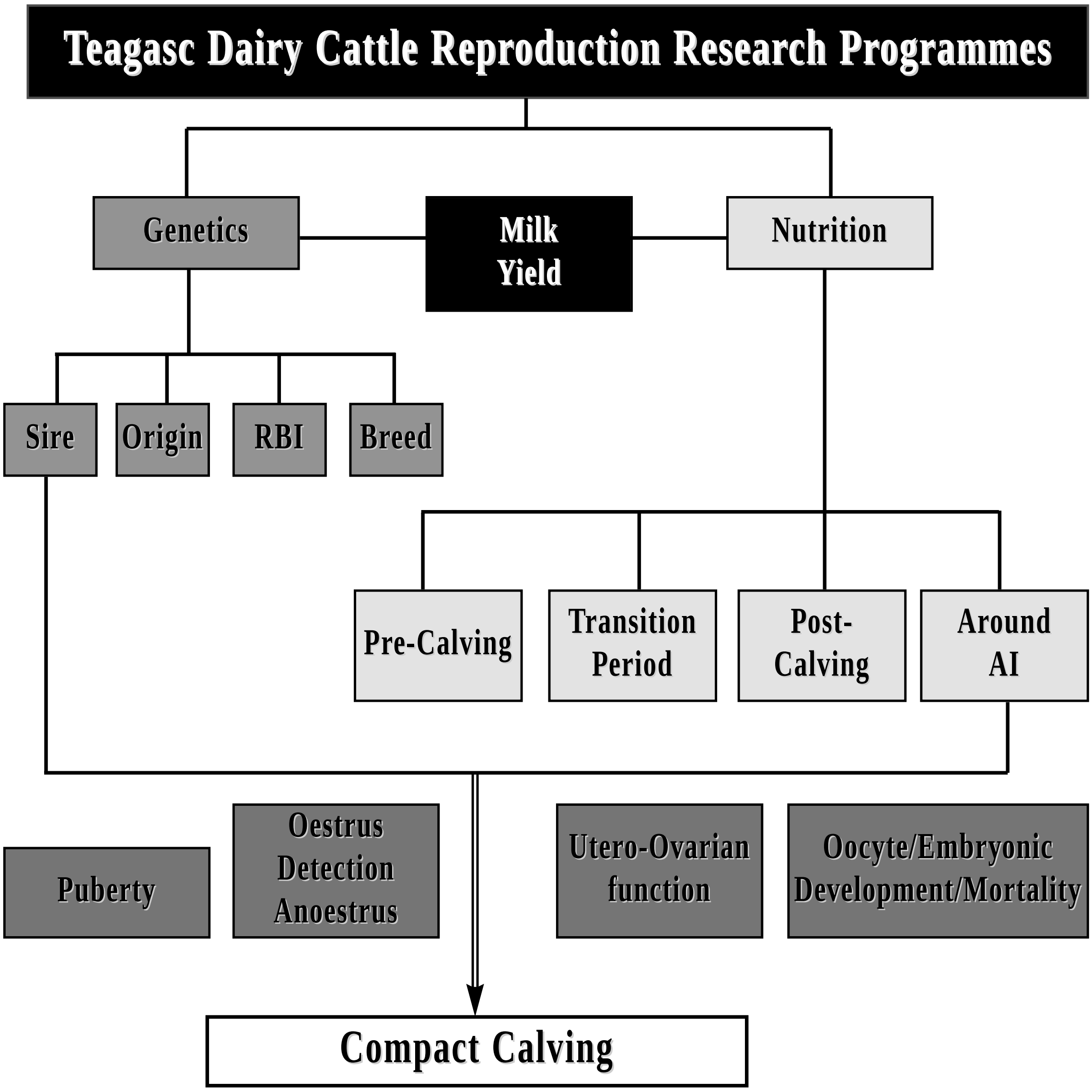
Figure 2 :



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Increasing output from grassland future challenges

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Introduction

The dairy industry in Ireland is facing a far more competitive environment than ever before. Driven by changes in the Common Agricultural Policy and World Trade Agreements the industry is undergoing massive changes both nationally and internationally and faces many new challenges. Grassland is the single most important agricultural resource in Ireland and is the pivot around which the dairy industry revolves. Successful dairy farming in Ireland is due to a large extent to the efficient conversion of grass to milk. Grass when grazed efficiently is by far the cheapest feed available on the dairy farm (Dillon, Cliffe and Hurley, 1991). Grazing management should aim to provide a supply of nutritious herbage over the growing season, at low cost, avoiding wastage and inefficient utilisation of herbage by the animal, and maintaining the productive capacity of the sward. The needs of both the animal and the sward need to be considered, and sever adverse effects on either should be avoided.

Our understanding of the feeding and management of the dairy feed has improved in recent years. Some of the changes that have occurred have been influenced by the application of EU milk quota regime. Considerable changes in our thinking in relation to calving date, pasture quality and more recently in relation to the use of pasture measurement. Likewise there is the realisation that the cow of today is not the same as that of yesterday. The blueprint for efficient milk production in Ireland recommended from Moorepark has changed to reflect this new reality. This paper attempts to highlight the most important issues in relation to the feeding and management of a spring-calving herd under the following headings:

1. Pre-calving nutrition (Dec-Jan)
2. Early lactation feeding (Mar-Apr)
3. Milk from grass (May - Sept)
4. Autumn Management (Oct – Nov)
5. Cow Type

1. **Pre-Calving Nutrition (December/January)**

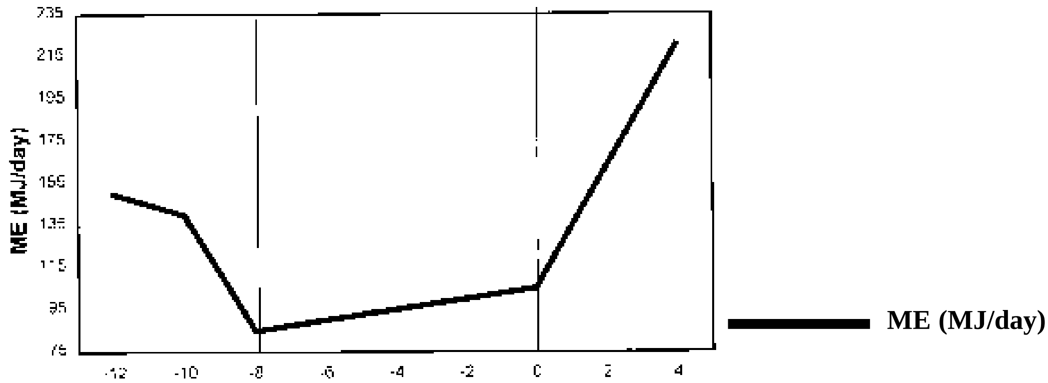
   In Ireland most spring-calving cows will be fed grass silage pre-calving. The dry period should be a time of preparation for the coming lactation. Careful attention to the needs of the dry cow can pay dividends in terms of improved lactation performance and reduced incidence of production diseases. There are a number of inter-related management factors during the dry period which influences milk production in the subsequent lactation. These include:

   - Body condition score at drying off.
   - Nutrition during the dry period.
   - Management at parturition.

Body condition score at drying off

At the end of lactation the herd average body-condition score should be on average 2.75 or greater. Equally important is the spread in condition score in the herd as this can vary from farm to farm. Body fat reserves are important for the dairy cow. In early lactation, there is usually a delay between maximum milk yield and maximum intake of dry matter (DM) and dairy cows are often seen to lose appreciable amounts of body weight over this period. Therefore, the cow must draw on fat reserves to make up the difference. Cows with a body condition score of less than 2.5 at calving will have decreased milk production and reproductive performance in the subsequent lactation. Cows with a body condition score of 3.0 will produce similar milk yield to cows scoring 4, provide the level of nutrition post-calving is high. The target condition score at calving can be manipulated by the level of feeding in late lactation, the silage quality in the dry period and the length of the dry period. The energy required of a spring-calving cow in late lactation, the dry period and early lactation are shown in Figure 1. The energy requirement of a dry cow, to maintain herself and the unborn calf, are much less than that during late lactation. In a milk quota situation the length of the dry period can often be used as a management guide in achieving target condition score at calving. A realistic increase in condition over an 8 to 10 weeks dry feed on good quality silage (70-72% DMD) would be an increase of 0.3 to 0.4 units of a body condition score. weeks dry feed on good quality silage (70-72% DMD) would be an increase of 0.3 to 0.4 units of a body condition score.

Figure 1. Typical energy (ME) requirements of a 600kg cow



The data in Table 1 shows how the length of the dry period could vary for cow with various body condition scores and lactation numbers. The condition score of cows at the end of their 1st lactation is generally less than for mature cows. If milk quota is not limiting, condition score can be increased in late lactation with a higher level of supplementation and, therefore reduces the length of the dry period.

Table 1. Length of dry period for cows of varying condition scores (weeks)

Condition score in late lactation	**2.0**	**2.5**	**3.0**	**3.5**
1st lactation	14	12	10	8
2nd lactation and greater	12	10	8	6

Nutrition during the dry period

Cows should calve at a body condition score of 3.25 to 3.50. The data in Table 2 shows guidelines for feeding during the dry period for cows of various body condition scores with a range of silage qualities over a 8 to 10 week dry period. The level of concentrate supplementation with cows of low body condition score will be very much influenced by the silage quality.

Table 2 Guidelines for feeding in dry period

	Body Condition Score			
Silage DMD (%)	**<2.5**	**2.5**	**2.75**	**3.0+**
73+	S + 1kg Conc	S	SR	SR
68-72	S + 2kg Conc	S + 1kg Conc	S	SR
<68	S + 3kg Conc	S + 2kg Conc	S + 1kg Conc	S

S=Silage ad libitum, SR= Silage restricted

The results of table 3 shows the importance of mineral supplementation during the dry period on a grass based system. The requirement for mineral supplementation in the dry period is much more important in a system where the level of concentrate supplementation during lactation is low. Therefore, mineral supplementation in the dry period should aim at preventing cows with deficiencies in trace and macro minerals or being pre-disposed to milk fever after calving.

Table 3. Effects of feeding system on mineral status end of lactation

	Copper (umol/L)	Selenium (IU/gHb) (GPX)	Iodine (ug/L)	Zinc (umol/L)
Low concentrate	13.6	76.5*	35.1*	16.2
High concentrate	13.4	133.0	106.0	19.4

* low to marginal

In recent years work at the Scottish Agricultural College (SAC) has shown that feeding a high protein concentrate supplement for 3 to 4 weeks pre-calving increase milk protein percentage post-calving. Table 4 summarises the results of 5 other studies in recent years. All 5 studies showed that there was no response in milk yield or milk protein in feeding a high protein supplementation pre-calving with a grass silage based diet.

Table 4. Pre-calving feeding of protein supplement (with grass-silage)

3 Scottish Exp	. + response
2 Moorepark Exp.	no response
2 Welsh Exp.	no response
1 Hillsborough Exp.	no response

Management at Parturition
Freshly calved cows (especially 1st lactation heifers) are very vunerable and should be treated with care and attention. Heifers should be introduced to the herd and milking parlour prior to calving. In large herds it may be worth while having a separate group of very early lactation cows.

2. **Early Lactation Feeding (March/April)**
Early lactation (0-12 weeks after calving) is a critical period in the nutrition of the dairy cow. Peak milk yield occurs around week 6 to 8 of lactation while peak intake does not occur until week 12 to 14 of lactation. Therefore, early lactation feeding is focused on avoiding excessive body weight loss. A bodyweight loss of 0.5 kg per day for the first eight weeks of lactation is acceptable. The target is not to lose greater than 30 kg bodyweight or greater than half a body condition score unit post-calving to the start of the breeding season.

The data in Table 5 shows the recommended concentrate feeding levels for herd yield up to 1300 gals. per lactation with a RBI(95) of 115 when grass silage is the forage source. Early lactation supplementation should be increased by 2 to 3 kg per day with higher yielding herds (1400 to 1700 gals). However, in recent years grazed grass has become part of the diet of most spring-calving herds in early lactation.

Table 5. Recommended levels of concentrate supplementation with silage of different DMD %

Silage DMD (%)	Supplement (kg/cow/day)
75	6
70	7
65	8
60	9

The data in Table 6 highlights the benefit of early spring grass in the diet of the spring-calving cow. The proportion of grazed grass available per cow will have a large influence on the level of concentrate supplementation required. An intake of 6 to 8 kg of grass DM per day in early lactation has a concentrate sparing effect of 3 to 4 kg of concentrates. Grass supply will be influenced by previous autumn grazing management, overall stocking rate, calving pattern on the farm and the genetic potential of the herd. On most dairy herds a certain level of concentrate supplementation will be required up until the end of April.

Table 6. Effect of early turnout to pasture

	Grazed grass	Grass Silage
Milk yield (kg/day)	42.3	39.6
Fat & Protein yield (kg/day)	3.20	2.84
Concentrate (kg/day)	5	9
Grass DM Intake (kg)	17.2	-
Silage DM Intake (kg)	-	10.4
Total DM Intake (kg)	21.5	18.2
Bodyweight change (kg)	-0.3	-1.0

Compact calving prior to the start of the grazing season is a priority for spring-calving herds. Dillon et al. (1995) showed March calving cows produced up to 80% of their milk from grazed grass. Calving should commence four weeks prior to the expected turnout day to grass. If the expected turnout day is in early March, then the breeding season should begin in late April. The large responses in terms of milk yield, protein percent and lower liveweight losses from spring grass is well documented (Dillon, 1996). Grass growth rates will not meet daily cow demand until mid to late April period. It is important that the first rotation does not finish before mid to late April.

Grazing Management

The aim during this period is to maximise the amount of grazed grass in the cow's diet, while at the same time aim to have a farm grass cover of greater than 850 kg DM\ha. by late April. A feed budget can be used to reach the required targets. The key points regarding turnout and budgeting early grass supply are:

- At turned pre-grazing yields should be > than 1000 kg DM\ha, and a daily grass allowance should not be less than 5 kgs DM\ cow\day.

- The available grass supply should be budgeted so as to finish the first grazing rotation between the 10th to 21st of April.

- Aim for a target farm grass cover of 850 kg DM/kg in late April (at a stocking rate of 4.5 cows/ha).

- Good grazing management practices such as block grazing and a good farm road network will reduce the risk of soil damage during the period.

3. **Milk from Grass (May to September)**

   The objective over this period is to achieve high cow performance from a complete grass diet. With a mean calving date in late February this period will cover 150 days of lactation (day 65 to 220of lactation) or greater than 50% of the total lactation milk yield. High cow performance will be achieved by maintaining a constant grass supply for the herd on a daily basis. Weekly monitoring of farm grass cover will assist this. In period of grass shortage where stocking rate cannot be adjusted to increase grass supply, supplementation may be required.

Adequate grass supply
The information in Table 7 shows the grass allowance/intake/milk yield relationship of a series of experiments carried out at Moorepark (Maher et al., 1997, 1998). The results show that the optimum daily grass allowance is 20kg DM/day for cows with an RBI (95) of 110. The lower grass allowance (16 to 17 kg DM/cow/day) resulted in very low post-grazing heights. This will in turn result in much reduced grass growth rates in the subsequent rotation. The milk yield and protein content are much reduced with the lower grass allowance. The high grass allowance (23 to 24 kg DM/cow/day) will result in more pasture topping for only a small increase in cow performance.

Table 7. Effect of daily grass allowance (kg DM/cow/day) on milk production

	Grass Allowance (>4cm)		
	16-17	**20**	**23-24**
Milk yield (kg/day)	22.5	23.6	24.5
Protein (%)	3.33	3.37	3.39
Post-grazing height (cm)	4.5	5.5	6.6
Grass DM Intake (kg)	15.3	16.4	17.1

Cows with higher milk yield potential i.e. higher RBI (95) will require higher daily grass allowances.

Table 8. Milk yield, grass intake & allowance in May/June for cows of different milk yield potential.

	Milk Yield Potential(kg)			
	5,000	5,800	6,580	7,500
Daily milk yield (kg)	22	25	29	33
Grass allowance (kg)	19.0	20.5	22.0	25
Grass intake (kg)	15.25	16.50	18.25	19.50

Table 8 shows the allowance/intake/milk yield relationship for cows of different milk yield potential. Research results from Moorepark would indicate that under good grazing conditions that the above intake levels are achievable.

Concentrate Supplementation

In a review of experiments carried out at Moorepark (Stakelum et al 1988) showed an average response of 0.38kg milk per kg of concentrate fed with summer supplementation where grass supply was adequate. Other review results showed similar or even small responses (Leaver et al 1968, Journet and Demarquilly,1979). More recent concentrate supplementation studies have shows higher responses with higher yielding cows (Buckley, 1999).

Table 9 shows the milk production for cows of high (HM) and medium genetic merit (MM) on two concentrate input systems. The average response was 1.12 and 0.92 kg milk per kg extra concentrate fed for the HM and MM cows, respectively, of solids corrected milk. The MM cows in this study would have been considered high yielding cows in the previous reviews.

Table 9. Effect of level of concentrate input & genetic merit (milk Yield) on the performance of spring-calving dairy cows.

	MM	HM	MM	HM
Conc. Fed (kg)	695	695	1,340	1,340
Milk yield (kg)	6576	7632	7221	8142
Fat (%) 4.11	3.76	3.96	3.97	
Protein (%)	3.39	3.37	3.45	3.41
Fat (kg)	266	286	285	321
Protein (kg)	222	257	249	277

HM = High merit, MM = Medium merit

The results in Table 10 shows the reproductive performance for cows on grass only compared to cows supplements with 5 kg of concentrate daily during the breeding season. These results indicate that where grass allowance is adequate there is no improvement in reproductive performance with concentrate supplementation.

Table 10. Effect of concentrate supplementation on reproductive performance (Adequate Grass Supply)

	May - July	
Concentrate (kg/cow/per day) 1 day	**0**	**5**
Submission 1st 3 weeks (%)	89	88
Calving to service interval (days)	78	77
Calving to conception interval (days)	92	92
Preg to 1st service (%)	63	63
Preg to 2nd service (%)	49	47
Services/cow	1.61	1.61
Not in calf (%)	11	10

Grass shortage

Grass shortage may occur during this period as a result of very high stocking rates or poor grass growing conditions. At pasture if cows are offered 20 kg DM/day this will achieve an intake of 17kg DM with a post-grazing height of 5 to 6 cm. The depression in intake for each kg reduction in grass allowance is 0.45. However, if daily allowance is 14kg, intake will be close to 14 kg and grazing will be very tight (3.5 to 4cm post-grazing height). Supplement will be required here. The additional benefit will be the avoidance of severe over grazing which would delay recovery of grass after defoliation. In this situation two types of supplement may be fed:

(a) Concentrate
(b) Forage e.g. silage

Concentrate

The milk yield response to concentrate supplementation will depend on the level of grass intake, yield potential of the cow, and the level and type of concentrate. The main reason for variation in milk yield responses is the existence of substitution rates of the added concentrate for the grazed herbage. Moorepark results would suggest that at daily intakes of 10, 12, 14, 16, and 17kg of grass DM result in substitution rates of 0.20, 0.32, 0.44, 0.55, and 0.62 kg / kg of concentrate respectively, when cows are supplemented with 3 to 4 kg of concentrates. These substitution rates were with cows yielding 15 to 20 kg/day. With higher yielding cows the level of grass intake would be higher to get the same substitution rates. High digestible fibre type concentrates (e.g. beet pulp, citrus pulp, corn gluten, maze distillers, soya hulls). These have lower substitution rates, therefore higher milk yield responses than high starch diets (e.g barley/soya). Table 10 shows the effect of different energy supplements (4 kg DM per day) namely barley (B), molasses beet pulp (MBP) and brewers grain (BG) to spring-calving cows in mid-summer. The highest milk yield responses were obtained with molasses beet pulp while the lowest with barley.

Table 11. Effect of different energy supplements on performance at pasture from summer onwards.

	G	+B	+MBP	+BG
Milk yield (kg/day)	10.5	12.7	13.9	14.0
Fat and protein yield (kg/day)	0.81	0.94	1.10	1.02
Liveweight gain (kg/day)	0.6	0.7	0.8	1.00

G=Grass only; B=Barley; MBP=Molasses Beet Pulp; BG=Brewers Grains

Table 12 shows the reproductive performance for cows on grass only compared to cows supplemented with 4kg of concentrate daily during the breeding season inadequate grass supply situation. The results indicate that inadequate grass supply situation there is an improvement in reproductive performance with concentrate supplementation.

Table 12. Effect of concentrate supplementation on reproductive performance (Inadequate Grass Supply)

	May - July	
Concentrate (kg/cow/per day)	**0**	**4**
Submission 1st 3 weeks (%)	91	95
Calving to service interval (days)	60	56
Calving to conception interval (days)	80	68
Preg to 1st service (%)	41	64
Preg to 2nd service (%)	68	86
Services/cow	2.10	1.50
Not in calf (%)	18	9

Forage Supplementation

Grass silage if available in surplus to winter feed requirement may be used as a supplement to grazed grass. In a review of experiments were grass supply was limiting, the average substitution rate was 0.31 kg/kg of silage DM and the average milk yield response was 0.36 kg milk with good quality silage. Milk protein content is reduced compared to the grass only.

The concept of round bale silage has become popular in recent years. Round baled silage allows greater flexibility in relation to handling, quality and feeding when compared to pit silage. It fits in with grazing management systems, whereby surplus paddocks of grass may be easily removed by bailing. Therefore, there is the possibility of harvesting material of much higher quality when ensiled as round baled silage relative to pit silage. There is evidence from grazing studies that in a grass shortage higher milk yield and protein content responses are attained.

Grazing management

- Farm grass cover should be maintained at 900 to 1,000 kg DM / ha or 200 to 250 kg DM / cow on the grazing area.
- Pre-grazing yield should be maintained at 1800 to 2200 kg DM/ha.
- Pasture with high post-grazing residuals (>350kg DM / ha, > 7.5 cm post grazing height) should be topped.
- Grazing, to very low post grazing height (<5cm) will result in inadequate grass intake, reduced milk yield and protein content.
- Use pasture measurements to identify surplus and deficts.

4. **Autumn Management**
   The aim of this period of the year is to maximise the amount of grass utilised, while at the same time finish the grazing season with the desired farm grass cover so as to set up the farm for early grass the following spring.

Grazing management

- Rotation length should be increased from 21 days in mid / late August to 30 to 35 days by late September.
- Aim for a farm cover of 1100 to 1300 kg DM/ha (SR 2.75 cows/ ha) by late September.
- The rotation length should be 25 to 35 days with first paddocks rested from mid-October.
- Closing farm grass cover in late November / early December should be 400 kg DM / ha, with a range in paddock cover of 200 to 900 kg DM /ha.
- Paddocks should be grazed well into last rotation to encourage Autumn/Winter tillering.

Supplementation

Studies at Moorepark have shown that generally the best responses to concentrate supplementation are achieved in the Autumn. Table 13 shows the benefit of supplementing such pasture with low to moderate levels of silage or concentrate with spring-calving cows (O'Brien et al., 1995) The silage was of good quality (72% DMD) and the concentrate was based on sugar beet pulp. The experiment was conducted from late-September to late-November and grass supply was considered not limiting. Supplementing grass with grass silage was of no benefit while supplementing with concentrate resulted in a good milk yield resistance. Therefore, from this study it can be revealed that feeding a low level (2 to 3 kg) of concentrate with autumn grass is worthwhile, provided the production is within milk quota. However feeding grass silage of medium to good quality in an adequate grass supply situation has no advantage.

Table 13. Effect on milk production of supplementing Autumn pasture with silage or concentrates

Supplement	None	Silage		Concentrates	
Level fed (kg/DM/day)	0	2.1	3.2	1.8	3.6
<u>**Daily Milk Production**</u>					
Yield (kg)	11.2	11.2	10.6	13.0	13.8
Fat (g/kg)	42.9	41.2	40.2	40.7	39.1
Protein (g/kg)	37.6	36.8	36.7	37.4	38.1
Fat + Protein (kg)	0.89	0.88	0.81	1.01	1.07
Kg milk/kg. DM supplement		0	-0.19	1.00	0.72

5. **Type of Cow**
   Worldwide, milk production per cow is increasing significantly as a result of increased genetic merit, and better feeding and management practices on farms. Within Europe, the Irish system of milk production is unique in that it is based on seasonal calving with a very large proportion of milk being produced from grazed grass. Results from Moorepark over the last five years suggest that the type of cow required for Ireland is unique and different to that which is available within Europe. Genetic improvement programmes should result in a cow that will produce a relatively high milk yield (5,600 – 7,022 kg/cow), of good milk composition (especially protein), good functional traits and last 3 to 4 lactation in the herd.

Moorepark Genotype – Breed evaluation
Moorepark has completed two studies in evaluating genotype / breed of cow over the past 5 years. The first study compares cows of medium (MG) and high (HG) genetic index cows in three contrasting systems of milk production. The pedigree index of the HG cows were 13 kg of fat and 14 kg of protein higher than the MG cows with an RBI(95) of 135. The HG cows were also almost 100% Holstein genetics while the MG cows had approximately 50%. The second study compares Normande (NM), Montbeliarde (MB), Holstein Friesian (HF) and a group of home bred Holstein Friesian (CL) breed.

Table 14 shows an economic analysis of the two Moorepark studies using a dairy farm with 181,600 litres (40,000 gallons) of milk quota. Opportunity cost of land was taken at £370/ha (£150/ac), with the amount of capital varying with the different breeds. The differences in milk price are a reflection of the differences in milk composition between the breeds. The number of cows milked is a reflection on the milk production and milk fat composition of the different genotypes/breeds to fill the 181,600 litres (40,000 gal) quota. The highest margin/cow was achieved with both HG and MG in the Moorepark study. The highest margin/litre was achieved
with the MG and MB genotypes. The factors that had greatest influence on margins were milk yield, milk composition and replacement rate of the different breeds/genotypes.

Table 14: Economic analysis of the Moorepark genotype / breed evaluation

	MG	HG	MB	NM	CL	HF
Cows Milked	26	24	32	34	34	27
Replacement Rate (%)	14	30	14	19	20	33
Milk Price (p/litre)	23.5	22.7	23.4	24.5	22.2	23.4
Margin / cow (£)	938	922	735	644	596	732
Margin / litre (p)	13.5	12.2	13.1	12.0	11.2	11.0
Ranked Margin/cow	157	155	123	108	100	123
Ranked Margin/litre	121	109	117	109	100	99

New Moorepark studies
A new research programme was set up at Moorepark in 1998 to further investigate the effect of genetic merit and feeding systems on cow performance. This was a follow on from the previous study set up in 1995 which finished in the Autumn of 1997 due to BSE outbreak. Both the HM (high merit) and the MM (medium merit) for the 1998 study were assembled from 9 Irish dairy farms (8 in Co. Cork & 1 in Co. Kerry) which had good breeding programmes.

The pedigree index for the high merit cows in the 1995 study was slightly higher (+71 kg of milk) than the new trial (1998). Also the level of Holstein Friesian genes was higher (+12%) in the high merit cows in the 1995 study. The pedigree index of the MM in 1998 was slightly higher than in 1995 study. The sires of the HM cows in 1995 were mainly Sunny Boy, Sunny Lodge Sammy and Nordkap, while the HM in 1998 are mainly sired by Carousel Amos, Etazon-Ferrari, Jabot and Sunny Boy. The sires of the MM cows in the 1995 study were mainly Arend, F16 Rocket and Etazon Bowi, while in the 1998 study they are Carousel Amos, Etazon Ferrari, New Way and Southwind.

Table 15 shows the fertility performance of the two genotypes over the last two years. The fertility performance of the HM cows in this study is much better than in the previous study (1995). The pregnancy rates achieved would allow a compact calving season to be maintained without large involuntary culling.

Table 15: The effect of genotype on fertility performance.

	Year	Genotype	
		MG	HG
Calving to service interval (days)	1998	82	82
	1999	75	77
Calving to conception interval (days)	1998	96	103
	1999	85	89
Pregnancy to 1st service (%)	1998	64	52
	1999	73	60
Pregnancy to 2nd service (%)	1998	47	52
	1999	31	53
Services per cow	1998	1.52	1.73
	1999	1.54	1.58
Not in calf (%)	1998	11	8
	1999	8	8

MG=Medium genetic index, HG=High genetic index.

Implications for increased genetic merit

The results show that on well managed herds the RBI (95) of the herd can be increased to 120 (50-60 % Holstein) with a milk yield potential of 6,850 kg/cow (1,400 gal/cow) without difficulties. Calving rates of greater than 50% will be achieved to 1st AI with less than 10% of cows not in-calf at the end of a 13 week breeding season. However, where RBI (95) is increased to130 (100% Holstein) calving rate to 1st AI service will be reduced to less than 40% with greater than 20% of the cows not in-calf at the end of breeding season. The genetic potential of a herd can be estimated from the pedigree information. If registered with the HFS this can be obtained from the pedigree certificate. If the herds are milk recorded, an index will also be issued. Results from Moorepark indicate that reduced reproductive performance may occur when a cow has:

- RBI (95) of >125,
- PD for milk production > 450 kg,
- > 85% Holstein genes

Farmers with dairy cows of such high index need to be careful with future breeding policy. In these situations, they should use sires that maintain milk production (+300 to 600 kg of milk) but increase milk composition (especially milk protein). Sires that are good in terms of female fertility and tested on a grass based system of milk productions should be selected.

In low to medium genetic index herds (95 to 110 RBI 95) the genetic index of the herd can be further increased. Priority should be given to sires that are +250 to 500 kg of milk, positive in milk protein concentration, and tested on a grass based feeding system.

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Improving cow performance with increased use of grazed grass

Sean and Angela Leonard,
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Farm Details:
Total land area is 70ha, divided into three blocks. On the home farm there is a total of 44ha of which 39ha is allocated to the dairy herd. The remaining 5ha is divided equally between sugar beet and barley/whole crop. The heifer replacement area is a 18ha outside farm, the other 8ha outside farm is run as a dry hogget unit. The total farm is integrated into the REPs scheme. The soil type is free draining of a brown podzolic soil structure. The home farm is located on a tributary to the Lee Valley, some of the lower farm is exposed to flooding. A total of 50 dairy cows are milked to fill a quota of 77,000 gallons. It is a total Spring calving herd with a mean calving date of February 11th.

Labour Units:
2 labour units on the farm, my wife Angela and myself.

Milk Production
Table 1 shows the milk production of the herd over the past three years. Milk yield per cow has increased by 1142kgs/cow (244gal/cow). In the past two years we have leased more quota, rather than increase cow numbers, we have chosen to increase milk yield/cow to fill the extra milk. Over the three year period milk protein concentration increased from 3.20 to 3.34%.

Table 1. Farm Production performance (1996 -1998)

	1996	**1997**	**1998**
Milk Yield (Kgs/cow)	6039	6507	7181
Protein (%)	3.20	3.24	3.34
Fat (%)	3.69	3.70	3.79
Fat Yield (kgs)	223	237	272
Protein Yield (kgs)	193	211	240
Total Solids (kgs)	416	448	512

Feed budget
Table 2 shows the feed budget for the herd for the past three years. The majority of the increase in cow performance has come from feeding the animals better at grass. Cows are at pasture for 290-300 days of the year. As the cows calve they are turned out to grass in early February, housing is usually late November/early December. The quantity of silage and concentrates fed has not changed much during the three years.

Table 2. Total feed budget (DM/cow) 1996 -1998

	1996	1997	1998
Grass (Allowance)	3.9	4.7	5.7
Conc	0.4	0.4	0.6
Silage	1.0	1.05	1.0
Maize	0.4	0.34	-
Total	5.7	6.5	7.3

The higher input of grazed grass was achieved by :

a) *Increased grass availability in Spring*
Generally paddocks are closed in rotation starting October 10th. The closing farm cover therefore has a wedge shape to it i.e. the paddock with the highest cover is the first closed paddock, the paddock with the lowest cover is the last closed paddock. Early nitrogen is applied in January whenever ground conditions and soil temperatures allow. As cows calve they graze by day and when grass supply allows grazing by night starts.

b) Increased grass availability in Autumn
With the low stocking rate we can generally graze until late November depending on ground conditions. With the total farm available to graze after second silage our farm cover increases to large levels during September and early October.

c) Increased daily allocation of grass (mid-grazing season)
With the potential of the herd we aim to fully feed the cows at grass. This requires a larger grass allowance i.e. 23 kgs DM/cow/day. We closely monitor milk yield and milk protein, combining the three together grass allowance, milk yield and milk protein provides us the indications whether we are feeding the animals correctly or not.

Grassland Management/Measurement:
We have been part of the Moorepark grass measurement project for the past three years. Since it's inception we have learned quite a deal about - grass cover, grass allocation, post grazing height and monitoring the animal factors i.e. milk yield/milk protein and cow condition score. We base our grazing management on four cornerstones :
(a) Farm cover
(b) Pre-grazing yield in paddock
(c) Daily grass allocation
(d) Post grazing sward height & grass quality

(a) Farm cover
We generally aim to keep our farm cover at 900 - 1000kgs DM/ha. This means keeping a high amount of kgs DM available per cow. The possibility therefore of running out of grass is usually low, however it has happened on a number occasions most vividly during the mid April period of 1998.

(b) Pre-grazing yield in paddock ahead of herd
We find that pre grazing yields in the region of 1700 - 2200 kgs DM/ha (>4cm) are suitable for grazing adequately with dairy cows. If pre grazing yields along with farm grass cover get too high then the surplus grass is taken out either as baled or pitted silage. If pre grazing yield gets too high while farm cover is not, then paddocks are topped post grazing.

(c) Daily grass allowance
Our low stocking rate allows us to allocate a large amount of grass in early lactation. Grazing by day has been Feb 22, Feb 4 and Feb 4 in 1997, 1998 and 1999 respectively. Grazing day and night has been March 7, Feb 21 and Feb 11 in 1997, 1998 and 1999 respectively. We aim to allocate the cows up to 23 kgs DM/cow/day during the main grazing season. Concentrates maybe fed during main grazing season when grass supply is poor. The key measurements in achieving high performance from grazed grass are daily monitoring grass allocations, post grazing sward height, bulk tank reading and milk protein percentage.

(d) Post grazing sward height & grass quality
With the high daily grass allowance pasture quality is maintained at grazing to about 5.5 - 6.5cm. If the target post grazing height are not obtained then pastures will be topped. In general pastures are topped twice in any grazing season. Pasture quality is also maintained by alternating grazing and silage cutting area. There is no defined grazing and silage cutting area on the farm.

Breeding Policy
Table 3 shows the RBI 95 of the herd over the past three years. Up to 2 - 3 years ago the sires used increased milk yield without any large increase in milk composition such sires include WYT, OMR, AWY and SSB. Over the last 2 to 3 years we have used mostly JOS, MAU, GMI and MFX on our herd. Our future breeding programme will focus more on increasing milk solids while still increasing milk yield. The type of cow we want in the future is one which yields 1600-1700 gallons @ 4.0% fat, 3.5% @ protein, strong muscled with good feet and udders and lasts in the herd for 4 to 5 lactation's.

Table 3. Herd predicted index profile (1996 - 1998)

	Milk (kg)	Fat (kg)	Protein (kg)	Fat (%)	Protein (%)	RBI 95
1996	186.3	6.9	5.9	-0.01	0.00	110
1997	234.1	7.9	7.0	-0.01	0.00	111
1998	254.8	9.1	8.1	-0.01	0.00	113

Table 4 shows the fertility performance of the herd for the past three years. Up to now we have had no major fertility problems however the breeding season is given a lot of attention with the use of tail paint, pre service scanning and scanning for pregnancy. Without these aids our infertile rate would definitely be larger.

Table 4. Herd Fertility performance (1996 -1998)

Year	1996	1997	1998
Cows served in first three weeks (%)	77	86	80
Calving to 1st service interval (days)	110	75	80
Services per conception	2.1	1.7	1.95
Pregnancy rate: 1st service (%)	44	60	66
2nd service (%)	56	47	27
3rd service (%)	42	86	20
Infertile Rate (%)	10.4	4.8	14

We are now involved in the Moorepark fertility study - and hopefully we will receive the revelant guidance as to where to focus our future breeding policy and what to breed for.

Cost structure and future direction of the farm
In the medium term we would like to increase our quota size. This will mainly be achieved through leasing more quota. Our current cost base is quiet low, our fixed costs are running at 38.3p/gal which

includes the cost of quota lease of (23.2p/gal). Variable costs are running at 23.9p/gal. There is possibly some room for reducing these costs further. One of the bigger problems about leasing extra quota is taking on more land. We do not intend putting non paying enterprises to use this extra land. We would hope to fill about 100,000 gallons of milk in the next 2-3 years. We will carry this extra quota with no extra labour cost. With our cost base, expansion in our current capacity is our main aim.

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Work Organisation on Dairy Farms

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Introduction

Labour is now an important issue in farming both in terms of cost and availability. A recent survey in Limerick showed 73% of the farmers felt they must increase their scale of enterprise to remain viable post 2006 (U.L / Teagasc). All farmers surveyed cited labour as having a major bearing on the sustainability of systems in the future. The experience of one farmer is typical of many around the country.

> *"This farmer had a 19 year old working on his farm for £40 a day, however he left for a local construction company as they offered him £65 a day. The farmer in question has now decided to reduce his scale of enterprise. The main reason was that he did not consider his enterprise large enough to match construction industry wages."*

If this trend continues it will be a serious impediment to the further development on dairy farms.

There are many aspects to labour. A study in Clare found farmers have long working hours and labour intensive systems (Gleeson, D. 1998). In Meath the findings were:

- 85% of these farmers have less labour now than 5 years ago.
- 6 out of 10 have problems sourcing labour.
- Farming is not able to compete with non-farm employers.
- Family members are making a big contribution to the farm labour force.
- 50% expect that labour shortage will affect enterprise mix in future (Meath Farming Future Clinton T, 1999).

Labour Survey in Limerick

Against this background we decided to investigate the labour situation on dairy farms in Limerick, with a view to finding out;

- the length of the working week
- the contribution of family labour.
- a breakdown of time by task
- the return per hour of labour
- the possibilities of reducing the workload

Three discussion groups in Co. Limerick were surveyed and participating members filled a daily time sheet for each day from the 9th to 15th August inclusive, detailing the length of the working week, whether by the farmer himself, family members contractors or other hired labour, as well as time devoted to each task. A profile of the participants is shown in table 1.

Table 1. Discussion Group Profile.

Total Hours worked/Farm/Week	50 – 70	70 – 90	90+
Farm Size (acres)	126	159	157
Herd Size	58	62	78
Quota (gallons)	54,775	65,600	76,000
No. calves and heifers	43	58	65
Other cattle	43	50	45

Farms were divided into three categories based on the total hours worked per farm per week. While scale of enterprise increased the workload there were other factors, like facilities and farm fragmentation that were also investigated. For example with 82% of farmers had fragmented holdings and involved cows crossing public roads or travelling long distances for milking. Leasing of milk tended to contribute to this problem as 64% of the farmers were leasing quota with land.

Length of Working Week
Diagram 1. Hours worked per Farm per Week

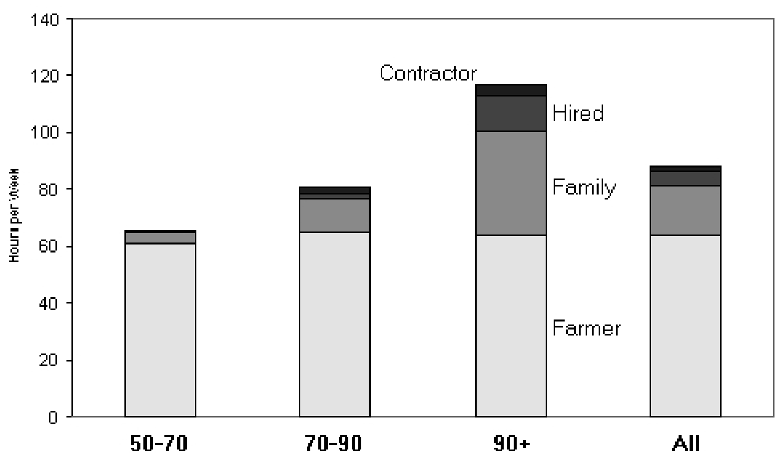


Diagram 1 shows the contribution that each category of worker makes to the total number of hours worked per farm per week.

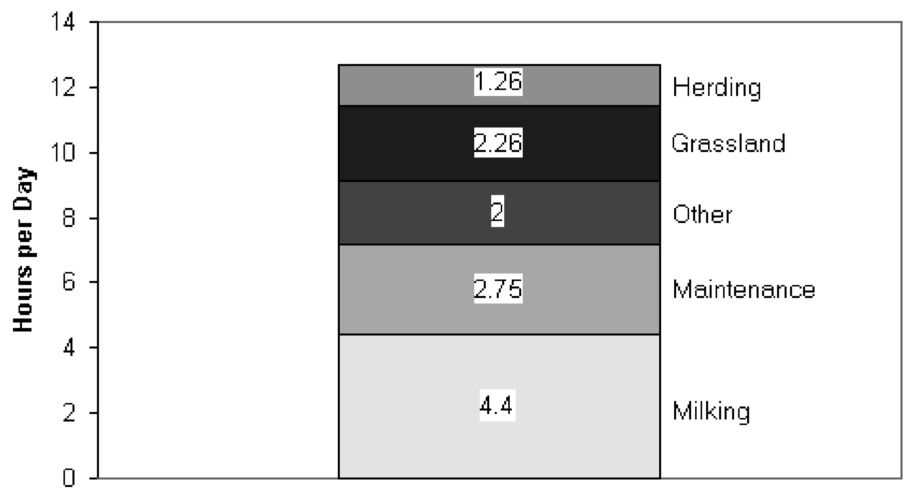
Farmers in all categories were working 60 – 65 hours/week with an average of 63. Family labour makes a large contribution especially in the 70-90 and 90+ category. As hours worked per farm per week increased, people resorted to more hired labour and made more use of contractors.

Average Working Day

The average working day was investigated. Tasks were divided into:

- milking = including moving cows to and from paddocks.
- maintenance = farmyard and fencing
- grassland = topping, moving fences, fertilizer, etc
- herding = cattle only
- other = administration work, animal health and feeding of cattle

Diagram 2 The Working Day

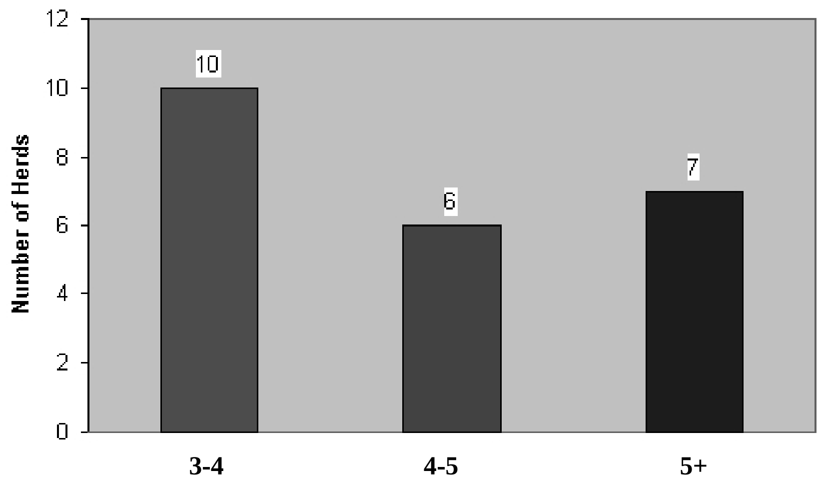


Milking takes up one third of the working day. Maintenance jobs were the second most time consuming chore and while they tend to be carried out at "slack" times of the year they need a lot of organisation and planning and are demanding on time. Generally the more enterprises the longer the working day. When hours are limited tasks that give a high return per hour of labour must get priority.

Milking

Since one third of every working day is spent milking we decided to have a closer look at variation in milking time between herds.

Diagram 3. Variation in Milking Time



Herd Size	53	72	82
No. Units	8	8	9
Cows/Milking Unit	6.6	9	9.1

For people with long milking times, it is important to examine the contribution of each task to total milking time. It is only then we can make progress with regard to saving time. Even a saving of 10 minutes per milking leads to a saving of two and a half hours per week. The range between herds for the various tasks involved in milking was shown in Table 2.

Table 2. Variation in Time per Milking Task

	Shortest (mins)	Longest (mins)
Move cows from paddock to collecting yard	5	45
Start to finish of milking (1st cluster on to last cluster off)	45	90
Wash up time, machine, bulk tank	5	20
Milking parlour, collecting yard, etc	5	20

Points of Note

- The biggest variation occurs in moving cows to and from paddocks.
- Milking time per batch did not show much variation between herd sizes once the number of units were matched to the herd.
- Certain tasks like milking machine washing can be automated.
- Properly sited power washers can make milking and yard cleaning easier.

Return Per Hour of Labour

A profit monitor was completed to estimate net farm income and this was used to calculate the rate of return per hour of labour. If we assume these are fairly typical hours we get a net return of approximately £5.50 per hour.
At this return there is no remuneration for their managerial skills/input.

In summary

- Labour problems exist on all farms irrespective of size or location.
- The farmers involved in our survey are working on average 60 – 65 hours per week irrespective of category.
- They are paid approximately £5.50 per hour, at this rate of return they are not being remunerated for their managerial skills.
- Family labour is making a significant contribution where the total hours worked per week is over 70.
- One third of the day is spent milking.
- Moving the cows to and from paddocks can take as long on some farms as actual milking on others.
- An increase in herd size did not necessarily mean an increase in milking time, once facilities matched the increase.
- Target maximum "milking time" of less than 4 hours per day.

Questions for the Immediate Future

- Is most use being made of the labour currently available on dairy farms?
- Can partnerships play a role in solving some of the labour problems on farm?

Farm Organisation and Strucutres for Efficient Labour Use

Matt Ryan - Teagasc

Why is it important to organise and plan our farms so as to deploy our own (+ family) and employed labour more efficiently each day, each week, every year.

- Employed labour is now less available and expensive.
- Family labour is entitled (and demands) to have similar hours and workload as their non farm friends. The next generation will not stay on farms if all they see at home is long hours and hardship.
- You, yourself , are entitled to reasonable time off and you need it.
- You will generate more profit by freeing up time for you to think and put your time to more productive uses.

MANAGING YOUR DAY:

For most of us the day isn't long enough to get all our work done and have time for our families. You have got to prioritise your day by better planning and management of time.

So, it is up to yourself and your family to sit down together and talk about this 'huge' problem. Make a plan. Decide on the length of your day: 7.00a.m. to 6.00p.m. (?). Your family will have loads of ideas what you can do with them after 6.00p.m. Put in place controls that ensure it happens.

Is the glass full?

= Your Day!

FILLING THE GLASS:

To understand this concept of planning your day lets' take a pint glass. Look at the diagram, but it would be better to do this yourself with your family looking on.

Step 1: Put in as many big stones into the glass as is possible. Is it full ? No. There are loads of spaces therein.

Step 2: Add in small stones to fill the spaces. Is it full now, No, as there are still spaces in the glass.

Step 3: What other solid material can be included ? Sand. Put it in. Is it full ? Pretty well. But can we get in anything else. Yes – water.

Step 4: Top it up with water. Is it now full ? Yes.

Step 5: Empty the glass contents into a large container.

Step 6: Put the whole lot of the contents back into the glass. Will they all go into it ? Yes or No ! Do it. No they won't. Which will not go in ? The first big stones will protrude out over the top. Which will go in first ? Water, of course and then sand. What does that tell you ?

YOUR DAY:

The glass is your day. It is made up of big jobs (big stones), small jobs (small stones), smaller jobs (sand), and unplanned chores (water). Can you list out the big jobs (most important or worthwhile) in your day, down to the chores that are nearly a waste of time. Please write them down with the help of your family and workforce.

I suppose the biggest job on dairy farms is the mornings milking and the evenings milking. The mornings milking generally takes place at a set time, either because the milk lorry is coming, the children have to be brought to school or some other issue that sets the time either for start or finish. But the evenings' milking is all over the place. Why ? Because, farmers have no time or issue to focus on. Maybe a match or funeral helps an odd time.

Therefore, those unplanned chores (the water) enter the farmers day to push out the evening milking outside normal working hours. What are these chores ? I have been told by farmers that they consider Salesmen, 'experts', visitors etc. who arrive at 4.30p.m. to 5.00p.m. in the evening, to fit into this category. Without being exceptionally rude to these people how can you deal with them and still keep your day intact ? Because you go for cows at 4.45p.m. and the salesman is only arriving you could suggest to him to walk with you for the cows while at the same time discussing the nature of his business. There are other ways of handling the situation.

Phone calls, the neighbour who constantly calls for the chat (and is'nt he welcome sometimes) can also fit into the 'watery' job category. Does the mobile phone help or distract ? Do not let these reduce your night time resting hours.

Other big duties in your day are going to your meals at set times. This is good for you but essential for the smooth operation of the home.

CONTROLS:

We must set an evening target for ourselves. Some of the ones I have come across are: 'must be in to see Home and Away' (don't laugh, it is working), "must be in to hear the 6 o'clock news", - really it should be to say the Angelus with the family, "must be in to have my working wife's dinner ready when she comes home at 6.30p.m." (has become very common).

PUT VALUE ON YOUR TIME:

Table 1:	**Returns per hour**		
	Laborious Chores:	£4 – £8	per hour.
	Management:	£ 30 - £100	per hour.
	Premia Form Filling:	£500 +	per hour

Table 1 gives a rough idea of what work gives highest returns on our time. Being able to free ourselves from labour demanding chores, (paying only £4-£8 per hour) will allow us put time into farm management during day light hours when we are mentally fresh. These management chores could be: doing grass budgets, cash flow budget, doing Profit Monitor, planning a work routine, preparing for meeting with Bank manager/Accountant/Expert, paying bills, ordering inputs, quotations etc . etc.

Laborious chores could be considered to be cleaning out calf houses, spreading slurry, covering silage pits, or any job anyone else can do once you tell him what to do.

AIDS TO A MANAGEABLE LIFE:

Farmers are constantly thinking and making things so as to make life easier. They must continue, focusing on those labour demanding issues raised by Martina O'Kearney – Flynn.

SIMPLE FARMING SYSTEM:

The more complicated and 'gadget' filled your system of farming the more labour (hardship) has to go into running it. It requires much more of your time to supervise it, as well as operate it. There is no doubt but that a grass based system of dairying requires less labour and management.

If possible only farm cows and replacements (or maybe not). Other enterprises add to time and labour demands as confirmed by Martina.

Avoid conacre to keep a cattle enterprise because of low profits.

REDUCE MAINTENANCE WORK.

- Good fencing.
- Good roadways (more of them).
- Good water supply.

Include these as a capital expense – borrowing accordingly)

- Start and finish in one go.
- Organise yards and buildings so that they can be tractor or scraper cleaned. Use straight runs.
- Organised equipment – tools – a place for everything. Discipline yourself and staff to put things back (always).
- Keep rainwater and slurry apart.
- "A stitch in time …" attitude to maintenance chores, for yourself and staff, making sure too cross them off when done as this act gives immense satisfaction.
- Use semi-skilled (handyman) labour to do some of this maintenance work.

USE CONTRACTORS MORE OFTEN:

- For silage cutting, slurry spreading, fertiliser spreading, etc.

I know a number of farmers, with little or no machinery who would use a contractor for almost everything. Their contractor costs are 6-7p per gallon – whereas others with their own machinery (not silage cutting) are spending 12-14p per gallon on contractor + machinery costs + depreciation and all the time and hardship that goes with it. Paying for a contractor will make you think twice about not grazing out a paddock and paying for topping, about letting water into the slurry tank.

Habits - Trips to town for little things.(if no car would you walk, cycle?)
Fixing gadgets
Untidy or careless

MORE EFFICIENT MILKING:

Facilities: Simple well planned herringbone parlours, with good collecting yards and drafting facilities are required so that one man can work 16-20 units, maybe 26 with automatic cluster removers on the last 6 units.

- Dump line.
- Narrow pit (5 ft.) with swing over clusters/wider with jars.
- Automatic milking machine washing.
- Wash jetters under cow standing.
- Batch feeding through automatic feeders.
- Motorised backing gate in rectangular/circular yard with a means of scraping large dung areas and some washing through the gate itself.
- Good power wash with appropriate connections in the yard.
- Effluent tank and mobile sprinkler.
- No steps or doors at entrance or exit.
- Simple drafting facilities on the exit (_ min v 3 min)
- More sophisticated system will be justified on some farms.
- Automatic bulk tank washing.

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MILKING ROUTINE:

There are over 12 individual tasks associated with milking routine from letting the cows into the parlour to letting them out or holding for bulling. Therefore, it is easy to understand how time can be lost (wasted) where a milker has a bad milking routine. I have observed two milkers in a 12 unit recorder plant taking 14-15 minutes per row.

Chores:
- Cows in
- Positioning
- Feeding meal.
- Strip.
- Prewash
- Mastitis/3 teats
- Clusters on
- Clusters off
- Teat Dip
- Marking Problem cows
- Cows out.
- Drafting sick/bulling cows

We must aim for a row time 7-9 minutes and a max of 10-12 rows per milking, so that milking doesn't take longer than 1.5 hours. With washing up to follow, it should be completed in an extra 30 minutes at max.

Many farmers need retraining in milking routine – I know one such farmer who took 20 minutes off his milking time for 100 cows by attending a training course.

Either go and milk with a good operator, attend a Teagasc Advanced Training Course, or talk to the Farm Relief Service who have a training programme for their relief milkers.

WALKING:

Depending on farm layout, a lot of time can be "wasted" going for and coming with cows. Motor bikes or quads can speed up this chore, but a well planned road structure with a good surface is the first essential. This will prevent single line walking, but this may be necessary in some situations, Farmers should go for the cows in time, so as to allow the cows time to travel – very little grass is eaten during the last hour before milking. The farmer could spend some of this time, either, setting up the next grazing area, topping, spreading nitrogen or herding cattle in adjacent fields.

MILKING INTERVAL:

Too many farmers don't know that you get the same milk yield from a 16:8 hour milking interval as you do from a 12:12 hour (see Table 2). Actually there is over £4 per 50 cows per day more money in the 16:8 hour milking interval. Because farmers fill the day between the two milkings with work this is an important fact to take in board.

Table: Effect of milking interval on daily milk yield and composition.

Milking Interval	16:8 hr.	12:12 hr
Milk yield (gals/cow)	5.36	5.34
% Fat	3.47	3.30
% Protein	3.29	3.28

Therefore, farmers who start milking at 7.30 a.m. can start the evening milking at 4.30 p.m. However, Pat Dillon, Moorepark, reckons that cows milking more than 22 Kgs (4.6 gallons) per milking would want to be on a 12:12 milking interval.

CALF REARING:

Very labour demanding. We need a change in attitude to sort out this problem. Use a mobile calf feeder to feed calves outside from 2-3 weeks old.

COMPUTER:

Will help to alleviate some or all of the bureaucratic demands being placed on you e.g. premia claims, animal remedies, fertility, accounts (costs/gallon). Transponder in parlour. Does take a lot of time – can family members help. Can you hire in a local skilled person to enter records etc., either in the computer or in the record books.

OFFICE AND PROCEDURE:

"Missus where did you put that letter?" A question to raise family temperature. Most farmers are handling between £100 - £300,000 annually, not to mention all the letters, bills and advice etc. Therefore, a good office structure is essential. Some outside help may be necessary or some personal training in office procedure may be worthwhile. I think 1-2 hours should be set aside, after the breakfast for 3-4 days per week to do office work. You will be mentally more alert and you will see it as part of your days work – but it is management time.

DEPLOY FAMILY/EMPLOYED LABOUR BY ROTA:

e.g. calving, milking a.m., p.m., weekends.

So as to communicate better with our family and working staff it is necessary to put some thought into how to communicate overall farm policy, day to day duties, or weekly duties. For example, plan to reduce morning or evening milkings from 7 times or (14) to 4 morning and 6 evening milkings per week. Or divide up calving day between the family: 4-9p.m. – children; 9p.m. to 12p.m. – mother; 12p.m. – 8a.m. – Father; 8a.m. – 4p.m. worker. Or whichever way the family agrees.

RESULTS:

This sort of planning will reduce duplication, misunderstandings, friction, fatigue and stress for all concerned. The result will almost certainly be higher farm profits.

Farmers should base their decisions on how to use their time each day on the following basis. Time devoted to manual tasks gives a return of £4 to £8 per hour, whereas time devoted to management tasks gives a return of £30 to £100 per hour. Farmers must take a positive view on filling premia and area aid forms because so much of their income is derived from this source.

FREE TIME:
What to do with it

- More time to educate yourself further. Remember knowledge is power.
- More time to plan new strategies/actions.
- More time to review and react.
- Assess grass cover and grass budget.
- Assemble accounts (not possible at night).
- Play golf or any other leisure pursuit.
- Go on holidays (without mobile phone).

SUMMARY:

Prioritise your day between your family, yourself and your work.
Prioritise the work you do based on economic returns.

Choose farming systems and work procedures that minimise labour demands, while at the same time being economically and environmentally justified.

Making Dairy Farming an Attractive Career

Colman Deely, Dairy Farmer,
Glenquin, Killeedy, Co. Limerick

Work is something you are doing when you would rather be doing something else.

For most of us work is necessary for survival. The challenge is to make our work as materially rewarding and as fulfilling as possible.

In a competitive economic climate with our country nearing full employment, human resources have become a valuable commodity. In this environment certain sectors will find it difficult to attract enough newcomers. In order for dairy farming to compete with other sectors of industry we have to be able to offer potential new comers three things:-

- Income: to reward labour and ability;
- Lifestyle: to have time to enjoy that income;
- Opportunity: to grow and develop farm business.

Personal and Farm Business Details

In 1991, after second level, I commenced the Certificate in Farming at Teagasc, Newcastle West while working on our home farm. My father joined the "Scheme of Early Retirement from Farming" in 1995 and I took over management of the farm. I have since completed the "Advanced Certificate in Dairying" at Teagasc, Newcastle West.

The farm consists of 130 acres of heavy gley soil ranging from 380 ft. – 550 ft. above sea level. I have an adjoining 30 acre hill farm leased as the enlargement for the retirement scheme. This goes from 400 ft. – 900 ft. Annual rainfall is 50-60 inches.

Livestock Numbers

Cows:		60
Cattle	0-1	40
	1-2	42
	2 +	5

Our main enterprise is a Spring calving dairy herd with a secondary calf-to-beef enterprise.

Milk Yield:	1,100 gallons/cow.
Meal Feeding:	450 kgs/cow.
Stocking Rate:	1.4 Livestock Units/acre.

I try to have cows on grass for between 260 and 300 days.

In 1995 we constructed an easy-feed slatted housing unit incorporating existing self-feed building. This accommodates all cattle in one unit. It was built in conjunction with joining REPS which helps finance it.

Why Dairy Farming?

My career choice lay between veterinary and dairy farming. Both offered satisfactory incomes, but I chose dairy farming because of the better lifestyle and the opportunity and challenge of managing a business.

Running an Attractive Dairy Farm

I can divide my year into three distinct work periods:-

- Spring - 70-80 hrs./week.
- Summer Autumn - 50-60 hrs./week.
- Winter - 20-40 hrs./week.

This structure allows me an attractive lifestyle with enough free time to pursue other interests i.e. hurling, rugby, Macra na Feirme, playing music, socialising, etc.

I take one to two week's holidays every year. This year I went to Norway, last year I sailed from Spain to Ireland in the Tall Ships race.

Work Organisation

On any farm there are different types of work, which are valued differently. I value my labour as follows:-

a) Manual Labour - £5-£10/hr.
b) Skilled Farmwork - £10-£20/hr.
c) Farm Business Management - £20-£50/hr.

This is where prioritising comes in. My first priority is business management, working on the farm business to ensure its continued growth. This involves developing a strategy and using tactics to implement that strategy.

Failing to Plan is Planning to Fail.

My second priority is skilled farm work i.e.

- grassland management;
- animal husbandry (including milking).

and in the spring

- calving and calf rearing;
- breeding.

To ensure that I can attend to these priorities, I use contractors for the following:

- Silage Making;
- Slurry Spreading;
- Feeding of Cattle in Winter;
- Plant Hire;
- Farm Building Construction;
- Some Spreading of Fertiliser in Spring;
- Post-driving and large Scale Fencing;
- Calf De-horning.

During the year help is also used for painting and maintenance of farm buildings, timber cutting or whenever there is a build up of work. A friend of mine milks for me during any holiday period.

Other Labour Saving Practices

❑	Compact calving	Increase in short-term workload. Separates calving from the breeding season, makes calf rearing easier due to closer batches.
❑	Calf Feeding -	Automatic calf feeder 0-3 weeks. Trolley and barrel 3-8 weeks. Calves deep bedded in shavings.
❑	Breeding -	Tail-painting. Running maiden heifers with cows.

Current farm targets can be divided into the **short-term and long-term.**

<u>Short-term Targets</u>

❑	Continued lowering of production costs	1997/'98	-	49p.
		1998/'99	-	43p.
		Target	-	35p.
❑	Improve milk protein percentage	1997	-	3.13
		1998	-	3.23
		1999	-	3.28
		Target	-	3.4

- ❑ Matching of stocking rate to grass growth curve, to maximise performance from grass.
- ❑ Re-examination and re-organisation of beef enterprises.

<u>Long-term Plans</u>

- Expansion of dairy herd, depending on availability of quota, to 80 cows and replacements.
- Continued Upskilling.

Tillage farmers say the most important place to cultivate is the top three inches of your head.

I have recently completed an Advanced Certificate in Darying at Teagasc, Newcastle West and found it an excellent course in both improved technical knowledge and stimulation from working with other progressive young dairy farmers.

Membership of discussion groups exposes you to other dairy farmer's experiences and perspectives and encourages comparisons and analysis of farm management practices.

All my farm management decisions are based on increasing **<u>total farm profit</u>** whilst maintaining my quality of life.

Making Dairy Farming an Attractive Career

My three key steps to making dairy farming an attractive career are:

1. Prioritise your workload;
2. Use contractors and relief services to allow socially And acceptable working lifestyle;
3. Work on the business.

Conclusion

I heard once that satan's greatest weapon was discouragement. I am optimistic about the future of Irish dairy farming. I believe everyone has a future in dairy farming, be it through:

- Increased efficiency;
- Expansion;
- Off-farm income;
- Partnerships/Sharefarming

or a combination of all these.

We have the **opportunity** to provide ourselves and our families with an attractive **income** and **lifestyle** through dairy farming.

Milk and Dairy Products for Better Human Health

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Abstract
Milk and dairy foods have retained a 'clean' image, despite the adverse food safety issues associated with a number of food products in recent years. In addition to the pure image and well recognised high quality nutritional value of milk and dairy products, continuing research is revealing the existence therein of novel health promoting activities of components or added components such as pre-or probiotics, some of which are currently being exploited for the development of added-value 'functional food' ingredients or neutraceutials. Functional Foods are described as 'foods which promote health beyond providing basic nutrition', positioning this food category beyond traditional nutrition science. This concept has stimulated much excitement within the food industry in recent times, and may provide potential opportunities for the Dairy industry. The global market for functional foods in the coming years is predicted to grow rapidly, and indeed, it is expected that product developments in functional foods could outstrip developments in low calorie and 'light' foods, a key growth area of the early 1990's. A number of health-promoting ingredients have been discovered in milk and dairy products, including those of milk protein and milk fat origin, which will be described in detail below. These include such components as bioactive peptides, e.g. casein phosphopeptides to promote mineral absorption which may help in preventing osteoporosis, fermented milks to alleviate hypertension and conjugated linoleic acid, a fatty acid with anticarcinogenic properties. In addition, dairy products such as fermented milks and yogurts containing 'probiotic' cultures such as lactobacilli and bifidobacteria, are currently among the best known examples of functional foods in Europe, with associated health claims ranging from alleviation of symptoms of lactose intolerance, treatment of diarrhoea, cancer suppression and reduction of blood cholesterol. Dairy foods provide the ideal food system for the delivery of these beneficial bacteria to the human gut, given the suitable environment that milk (and certain dairy products including yogurt and cheese) provides to promote growth and/or support viability of these cultures. Indeed, with the tradition of fermentation in dairy systems, the probiotic concept may be of greater relevance to the Dairy Industry as opposed to other sectors of the Food Industry and so positions dairy products at the forefront of functional foods.

Introduction
Until a few decades ago, few would have argued with the contention that milk and milk products made an extremely valuable contribution to the nutrition of the population, i.e. 'milk is good for you'. More recently, however, the image of milk has suffered due to the attention focussed on it's content of saturated fatty acids and their supposed contribution to high plasma cholesterol and associated coronary heart disease.

This paper will first discuss the general contribution of milk to optimal nutrition and then highlight recent research indicating that existing and novel milk products may have a beneficial effect on human health. In particular, the positive health attributes of milk protein and peptides, dairy fat and vitamins and fermented milks containing health promoting dairy cultures or probiotics will be discussed.

Milk Nutrition
In countries where dairying has been long-established, eating patterns include a substantial contribution from milk and milk products. It would be difficult for such populations to sustain an appropriate balance of nutrients such as calcium and riboflavin should dairy products be removed from the diet. Milk contains a good balance of protein, fat, minerals and carbohydrate. Indeed, consumer surveys have shown that consumption of dairy products contributes up to 20% of daily energy intake as well as up to 60% of calcium intake in these populations (Miller, 1989).

Milk proteins are easily digested in vivo to provide peptides and amino acids which are quickly metabolised by the human body. Lactose is the only carbohydrate present in significant quantities in milk. All newborn babies possess lactase which cleaves lactose to glucose and galactose which are converted to energy via metabolic processes. However, some individuals, Northern Europeans in particular, lose this enzyme activity in later life and may experience lactose intolerance. Such individuals are usually able to tolerate small quantities of milk products as part of a varied diet. Milk-fat, while containing a high proportion of saturated fatty acids, of which some raise plasma cholesterol, also contains up to 33% unsaturated fatty acids which have a cholesterol-lowering tendency. Ingestion of whole milk or fermented milk does not raise plasma cholesterol levels (Gurr, 1991). One litre of milk can provide significant amounts of the recommended daily allowance (RDA) of a range of vitamins such as Vitamin A (46% RDA/ l), thiamine (120% RDA/ l) and Vitamin D (32% RDA/ l). Calcium is quantitatively the most important mineral supplied in milk (150% RDA/ l) but significant contributions are also made to daily intakes of magnesium (40 % RDA/ l), zinc (30% RDA/ l) and potassium (75% RDA/ l), a point that could be stressed more by the dairy industry.

Boiactive Proteins and Peptides

Irish milk generally contains between 3.2- 3.5% protein, composed primarily of casein (80%) and whey proteins (20%). Milk proteins, upon ingestion, are broken down by gastrointestinal enzymes to produce a range of protein fragments (peptides), of which many have been identified as being bioactive. The biological significance of these peptides, their impact on human health and production of novel functional food ingredients containing these peptides are currently the subject of intensive research.

Caseinophosphopeptides

Caseinophosphopeptides (CPPs) are phosphorylated casein-derived peptides which possess the ability to bind and to solubilise minerals such as calcium. The excellent bioavailability of calcium from milk and dairy products has, in part, been attributed to the action of CPPs. It has been proposed that CPPs form complexes with calcium in the distal small intestine thereby facilitating passive absorption of the mineral. CPPs have been found in vivo in both animal models and in the duodenum of humans following ingestion of milk and yogurt.

CPPs can be produced industrially from sodium caseinate using commercial proteases. The bioactive characteristics and possible applications of the CPPs within these preparations are currently being investigated. The effectiveness of these CPPs in enhancing intestinal calcium solubility in rat and other animal models is a subject of continuing research. Recent human studies by Heaney et al. (1994) and Hansen (1995) have demonstrated that that CPP administration enhances absorption of co-ingested calcium in post-menopausal women or healthy adults.

While doctors recommend increasing the intake of calcium in order to prevent ostreoporosis and maintain good health, most calcium supplements are insoluble in the distal small intestine where absorption of calcium occurs. It has been shown in Moorepark that CPPs will inhibit the precipitation of a range of calcium salts under simulated gastrointestinal conditions, thereby making the calcium bioavailable. The relevance of this work is demonstrated by the findings of a recent U.S. study that supplementation of bioactive calcium (1200 mg/day for 34 months) in patients aged over 50 could save over $2.6 billion in direct medical costs (and prevent 134,764 hip fractures). CPPs may also find application in the prevention and treatment of dental calculus due to their anticariogenic properties.
Currently, the DPRC is the co-ordinator of a pan-European project with the objective of producing CPPs, completely characterising the physiological properties and applying CPPs in human calcium bioavailability studies. It is hoped that this research will lead to the development of a safe functional food ingredient for applications in calcium supplementation.

Antihypertensive milk peptides

Angiotensin-converting enzyme (ACE) is a multi-functional biological agent associated with the regulation of peripheral blood pressure in mammals. Inhibition of this enzyme is known to decrease hypertension. Recent research has shown that enzymatic digestion of casein and whey proteins generates peptides that have the ability to inhibit ACE. While the antihypertensive activities of these peptides do not compare to those of the commonly used drugs such as Captopril and Bradykinin potentiator B, mixtures of these peptides may exert protective anti-hypertensive effects, e.g. daily ingestion of Calpis, a fermented milk containing ACE-inhibitory peptides has been shown to significantly reduce diastolic and systolic blood pressure in hypertensive humans (Hata et al., 1996). Milk products containing such peptides are being developed to act as adjunct therapies in maintenance of good health.

Other bioactive peptides

Milk proteins contain peptide sequences which, upon release, prolong gastrointestinal transit time and exert anti-diarrhoeal action (Daniel et al., 1990a, b). These peptides have been found in human intestinal contents and blood plasma after ingestion of casein and/ or milk, thus indicating a bioactive role for these peptides. Peptides with immunostimulatory and anti-bacterial activities have also been identified and characterised in hydrolysates of casein and whey proteins. The human efficacy of these peptides in stimulating the immune system and inhibiting bacteria remain to be determined. Further studies into the bioactivities of these and other peptides are continuing.

b-casein A1 variant

Consumption of milk containing the A1 variant of b-casein has been linked, in epidemiological studies, to the development of ischaemic heart disease (McLachlan, 1996). Investigations into this possible link are continuing.

Whey Protein

Whey, a by-product of cheese and casein manufacture, contains significant quantities of protein. Whey proteins not only play an important role in nutrition as an exceptionally rich and balanced source of amino acids, but also seem to exert specific physiological actions. Bioactive effects ranging from anti-carcinogenicity to influence on digestion have been ascribed to individual whey proteins such as a-lactalbumin (a-La) , lactoferrin (LF) and glycomacropeptide (GMP). a-La-enriched powders are being used to "humanise" infant milk formulae. LF, and its derived peptide, lactoferricin, have been shown to have anti-microbial properties. LF has also been shown to have an active role in iron transport and regulation. Ingestion of GMP has been shown to slow gastric emptying in animals and is now being promoted as an appetite suppressant in the U.S.. Purified growth factors from whey have also been used to speed wound repair in animal models.

Crude whey protein preparations such as whey protein concentrate (WPC) and whey protein isolate (WPI) have been shown to exert an anti-cancer effects. Rats fed whey protein concentrate had fewer tumours and a reduced tumour mass index (TMI) as compared to a control group, after tumour induction with the potent carcinogen, dimethylhydrazine (Mc Intosh et al., 1995). A human clinical study has shown a significant regression in metastatic carcinoma patients' TMI when fed whey protein concentrate at ~30 g per day (Kennedy et al., 1995). It is postulated that whey protein somehow depletes cancer cells of a vital antioxidant, glutathione, thereby making the cells more susceptible to orthodox treatments with chemotherapy or radiation (Bounous et al., 1991). Other studies have shown that whey protein concentrate ingestion can boost immune response or lower liver and plasma cholesterol in rats.

Whey protein is also widely used by bodybuilders and other athletes to gain muscle mass quickly due to it's high digestibility and absorbability. While these biological effects have been shown for whey protein, it should be emphasised that the use of whey protein supplements is only recommended as functional foods for maintenance of good health.

Milk Fat and Vitamins

The evaluation of natural anticancer components of food is now an important element of overall cancer prevention strategy. Research indicates that bovine milk fat contains a number of bioactive components exhibiting anticancer potential. Dairy cows have the ability to extract anticarcinogenic components from pasture and feed and transfer them to milk. Bovine milk fat contains approximately 75 wt % of bioactive substances whose overall impact on human health is being assessed (Molkentin, 1999). Milk fat contains a number of bioactive components that have anticancer potential, including conjugated linoleic acid (CLA), sphingomyelin, butyric acid, ether lipids, b-carotene, and vitamins A and D. Although milk contains saturated fatty acids and trans fatty acids, which are associated with atherosclerosis and coronary heart disease, it also contains oleic acid which is negatively correlated with these diseases. Furthermore, milk fat contains the essential fatty acids, linoleic and linolenic acids that have many diverse functions in human metabolism and may control a variety of biochemical and physiological process.

Butyric acid has recently been the subject of intensive research due to its purported anti-colon cancer effects. It has also been shown to inhibit the growth of a range of cancer cells. Although the intake of butyric acid from the milk may not be high, its effects are enhanced several-fold due to synergy with other anticarcinogenic components of milk fat, e.g. vitamin A and D3. Research at Moorepark indicates that Irish manufacturing milk exhibits a seasonal variation in of butyric acid content, i.e. it is highest in March and April (4.5-4.7 % of fatty acids).

Twenty per cent of milk fat is composed of unsaturated fatty acids, i.e. oleic, linoleic and linolenic acids. Oleic acid is reported to decrease the level of LDL-cholesterol, whereas linoleic and linolenic acids are essential fatty acids and have diverse functions in human metabolism. The level of mono and polyunsaturated fat in milk can be elevated by dietary means. Studies at Moorepark have shown that the levels of oleic and linoleic acids in Irish milk fat can be increased to 43 and 2.3 % of milk fatty acids, respectively, by supplementation with full fat rapeseed.

Conjugated linoleic acid (CLA)

The biological properties of dietary CLA are currently attracting considerable interest due it’s diverse range of purported biological properties. Not only is CLA a powerful anticarcinogen, but it also has been reported to have anti-atherogenic, immunomodulating, growth promoting, and anti-obese properties. CLA have also been reported recently to possess anti-diabetic properties. CLA is produced naturally in ruminant animals and as a result milk fat is the richest natural source of CLA. Laboratory studies have shown that CLA inhibits the growth of a number of human and animal cancer cells and as little as 0.1% of dietary conjugated linoleic has been shown to have anticancer effects.

The levels of CLA in commercial Irish milk varies throughout the season, the higher levels corresponding with lush pasture supply. CLA values for Irish, Australian and New Zealand milk fat are often some 2 to 3 times higher than values reported for equivalent United States products, reflecting the greater access to fresh grass. Indeed, Moorepark studies indicate that lower grass intakes result in significantly lower levels of CLA in milk.

Recent research has shown that animal dietary and management practices can significantly elevate milk fat CLA levels. In feeding trials conducted in Moorepark increases of over 60 % and 28% in milk fat CLA concentrations were obtained by supplementing pasture diets with full fat rapeseeds and soybeans, respectively. These data clearly show that even in grazing situations where milk fat CLA content is already high it can be increased further by supplementation with oilseeds. To complement these studies, work in the US has shown that animals receiving CLA enriched butter (produced naturally from milk from cows receiving similar dietary regimes to those described above) in their diets had decreased incidences of cancer.

Sphingomyelin and Ether Lipids

Sphingomyelin represents less than 1% of milk fat and is receiving attention because it is now recognised as a tumor suppressor lipid. Dietary sphingomyelin and other sphingolipids may be beneficial to the intestine and other tissues. It has been shown that low concentrations of dietary sphingomyelin from milk reduced the incidence of colon tumours by 57% in mice.

Milk fat contains small quantities of ether lipids which have been shown to prevent invasion and spread of tumours and can also modulate the immune system. Although the therapeutic potential of ether lipids and derivatives thereof are being determined, the use of dietary ether lipids in cancer prevention has not been reported.

Vitamin D, A, b-carotene and other anticarcinogens

Vitamin D, through it's derivative 1a-, 25-dihydroxyvitamin D3 , has been shown to inhibit a range of cancers. An association between decreased intake of vitamin D and increased risk of prostate and colon cancer is suggested from epidemiological evidence. Milk is usually fortified with Vitamin D in Northern Europe and the U.S. as natural milk does not contain significant quantities of this vitamin.

Dairy cows have the ability to extract b-carotene, vitamin A and other anticarcinogens from pasture and feed and transfer them to milk. Vitamin A and b-carotene are probably the most widely investigated natural anticarcinogens and epidemiological studies indicate that people receiving diets rich in b-carotene and vitamin A have a lower risk of developing several types of cancer.

Milk Fermentations : Probiotic Products

Although the value of lactic acid bacteria (LAB) in food fermentations has been recognised for centuries, development of the probiotic idea is attributed to Elie Metchnikoff, who observed that the consumption of fermented milks could reverse putrefactive effects of the gut microflora (Metchnikoff, 1907). From these beginnings the probiotic concept has progressed considerably and is now the focus of much research attention worldwide. Significant advances have been made in the selection and characterisation of specific cultures and substantiation of health claims relating to their consumption. Consequently, the area of probiotics has advanced from anecdotal reports, with scientific evidence now accumulating to back up nutritional and therapeutic properties of certain strains.

Probiotics are microbial cell preparations or components of microbial cells that have a beneficial effect on health and well being of the host. The potential clinical applications of probiotic bacteria are many and varied. In all, 143 trials were conducted with probiotic cultures between 1961 and 1998 involving 7,526 human subjects, with many different microbial strains and species used either therapeutically or prophylactically in the treatment of various illnesses and physiological disorders (Naidu et al., 1999). The health effects attributed to probiotic consumption which have been best substantiated with scientific evidence include alleviation of lactose maldigestion, cancer prevention, prevention/treatment of infections, serum cholesterol reduction and modulation of the immune system. While the exact mechanism by which probiotics exert specific health effects is not completely understood, given the range of health benefits attributed to probiotic consumption, it is unlikely that each strain will act in the same way. In general, health effects are related to intestinal microflora modification and strengthening of the gut mucosal barrier (Salminen et al., 1996).

Foods containing probiotic bacteria fall within the functional foods category and increased commercial interest in exploiting the proposed health attributes of probiotics has contributed in a significant way to the rapid growth and expansion of this sector of the market. In addition to probiotics some dairy yogurts now also contain prebiotics which are non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, and thus improve host health. Many dairy products containing pro- and prebiotics with associated health claims have been launched onto the market (Table 1) and in some countries these are an established market segment. The trend is towards exploitation of the synergistic effect of combining probiotics with prebiotics, while some of the earlier products contained probiotic cultures alone (Table 1). Probiotic cultures have found most applications in yogurts and fermented milk products, and of these 'LC1' (Nestle), 'Vifit' (Campina Melkunie), 'Actimel' (Danone) and 'Yakult' (Yakult) have emerged as market leaders. The dairy market for yogurt, with it's existing health image, is well positioned to capitalise on the growth in healthy foods, benefiting additionally from the fact that it is a food that tastes good and is enjoyable. Many European countries are experiencing considerable growth in demand for existing probiotic products and there is a surge in the numbers of new products being launched. To highlight this some recent product developments will be discussed.

Developed in Japan in the 1930's Yakult, the fermented milk drink containing Lb. casei Shirota is now viewed as the world's leading mass-marketed functional food product and is sold worldwide in 23 countries at a volume of 16 million bottles per day. Marketed in 65 ml bottles containing 6.5 billion bacteria, Yakult is considered neither a food nor a pharmaceutical. Since establishing a European production base in The Netherlands in 1994, the Japanese company Yakult Honsha has extended distribution into Belgium, Luxembourg, the UK and Germany during 1995 and 1996 and plans to serve all European countries by 2005. Sales in Europe are now estimated to total 388,000 bottles a day and even in the challenging UK market, since its launch in 1996, Yakult has more than doubled its sales, securing a £7.2 million niche in the yogurt and pot-dessert market. Based on this performance, all the major multiples have moved to national distribution of the product. The advertising spend is expected to continue with further advertising backed by sampling of over 1 million bottles in-store and in the community and workplace.

Nestle's LC1, available either as a set cultured milk or as a drinking product contains the L. acidophilus strain La 1, recently renamed as L. johnsonii LJ 1. This Lactobacillus strain, chosen for its probiotic characteristics was the outcome of an extensive research effort conducted by Nestle. Based on human studies and supported by a strong scientific dossier, this culture is claimed to stimulate the immune system, leading to the statement 'helps the body protect itself'. In 1994, the launch of the LC1 product onto the French market took place costing $8 million and by the end of its first year it had seized an 11 % share of the French bio yogurt market. From this it has grown and in 1997 it had gained a 25 % market share. LC1 now accounts for 20 % of the company's European trade in yogurts and fermented milks and is the leading brand in the German yogurt market with a 60 % share. However, despite its success on the French and German markets and the fact that it is currently available in most European countries, a slower start for the LC1 product has been evident in a number of European countries, most notably the UK.

Marketing in the area of prebiotics has concentrated principally on oligosaccharides. Following confinement to the Japanese market, a number of products have recently appeared in Europe, in particular containing inulin (Table 1).

In general, there is much activity in the application of probiotics and prebiotics to foodstuffs. However, critical to the success of such functional foods are factors such as quality, price, market positioning, consumer education, advertising and , also an understanding of local market conditions and consumer attitudes. If these issues are addressed then the market for such products will continue to grow in association with the continued development of foods containing sufficient levels of viable probiotic microorganisms or effective prebiotic substances and backed up by adequate scientific substantiation.

Table 1. Some of the probiotic and synbiotic products currently on the market and their associated health claims

Product	Health claim
Actimel‘	reinforces your natural resistance…your daily dose of natural protection’
Actimel Cholesterol Control	‘helps, if taken regularly as part of a healthy and varied diet, to reduce you cholesterol values’
BIO Aloe Vera	‘feeds and hydrates in a very self-evident way: from inside out’
Biotic Plus Oligofructose	‘promotes the natural balance of the gut flora and thus your health…oligofructose stimulates the body’s own positive bacteria and increases (as dietary fibre) the activity and purification of the gut’
Daily FIT	‘a valuable contribution to fitness and health…positive action on the gut flora…stimulates natural resistance’
Fyos	‘promotes a healthy gut balance…take care of your whole health’
Fysiq	‘contributes to a healthy cholesterol level…this effect is strengthened by the presence of a dietary fibre’
Jour apres Jour	‘to help maintain your vitality….the bifidogenic fibres promote the development of the bifidobacteria (‘good’ bacteria in our body) and contribute to the balance and good functioning of the organism’
PRO’AC	‘ a valuable contribution to your health..cleans the gut in a natural way and stimulates the required natural activity of the organic cells’
Silhouette Plus	‘ the soluble bifidogenic fibres help to preserve and re-establish the balance of the digestive flora’
ProCult 3	‘ a positive influence o n the gut flora…additionally supported by the nutritious substance inulin’

(Coussement, 1997)

Conclusion

Bovine milk is a safe source of basic nutrients such as protein, carbohydrate, fat and minerals. Recent in the DPRC and elsewhere has shown that milk protein and milkfat also contain bioactive components that can exert specific physiological effects. These effects include aiding calcium absorption (caseinophosphopeptides), prevention of hypertension (ACE-inhibitory peptides) and anti-carcinogenicity (CLA, Butyric acid, Vitamin A, D, b-carotene). This research data allows milk to be classed as a functional food and will also stimulate further development of products containing different bioactive components for specific health applications. The market for probiotic products such as yogurt and drinks is expanding rapidly, reflecting consumer acceptance of the health benefits of such products and also an increasing tendency towards self-medication.

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