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Influence of Pasture Type on Animal Production

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The influence of pasture type on animal production has been the subject of much research and debate for many years. There are some aspects on which there is general agreement. For example, pastures with a good white clover balance are more productive than those without this legume. In Ireland and U.K. the more productive pastures have reasonably high levels of ryegrass. There is much less agreement on other aspects such as the relative merits of different varieties of ryegrass. Differences between ryegrass varieties in terms of dry matter yield under frequent and infrequent cutting are well established. There is, however, no reliable way in which productivity under cutting can be translated into animal performance.

The results presented in this paper deal with the relative performance of four varieties of ryegrass measured in terms of animal production over a period of six years. Three stocking rates were imposed on each of the four varieties as follows :

Varieties :

— Tailteann	:	Early	:	Poor persistency
— S 24	:	Early	:	Good persistency
— S 23	:	Late	:	Good persistency
— Reveille	:	Early	:	Tertaploid, medium persistency

Stocking rates : (at turn-out)	kg/ha
— Low	2,000
— Medium	2,500
— High	3,000

In such experiments it is necessary to include varying stocking levels in order to arrive at valid conclusions. This is the reason for the very high stocking rates which severely depress animal performance.

The level of nitrogen fertiliser use was 245 kg/ha/annum in five applications. The duration of the grazing season was from the first week of April to the first week of November and the grazing cycle was 20 days. Stocking rates were reduced by 45% in July after five grazing cycles.

Results

Liveweight gain from each variety averaged over stocking rates for each year is shown in Table I. Productivity was high. On the best treatments (Reveille and S 23 medium stocking rate) production was never

Table 1

Total annual liveweight gain (kg/ha) averaged over stocking rates

	1973	1974	1975	1976	1977	1978
Tailteann	1265	921	988	991	993	926
S 24	1200	977	1052	1060	1024	1001
S 23	1315	1002	1122	1124	1112	1085
Reveille	1306	1049	1138	1133	1096	1076

less than 1100 kg/ha liveweight gain in any year. The first year (1975) showed a very high level of production, this is a phenomenon frequently associated with new re-seeds where the performance in the initial year is some 10-20% higher than in subsequent seasons.

Differences between varieties are summarised in Table 2 in terms of carrying capacity relative to S 24 = 100.

Table 2

Stock carrying capacity of varieties relative to S 24=100

	1973	1974	1975	1976	1977	1978
Tailteann	105	94	92	93	98	93
S 24	100	100	100	100	100	100
S 23	109	100	111	107	107	108
Reveille	109	105	114	108	105	108

Table 3

Average dry matter yield (frequent cutting) relative to S 24=100

	1977	1978
Tailteann	96	91
S 24	100	100
S 23	92	95
Reveille	94	95

The main features of these results are :

S 23 and Reveille were consistently superior in stock carrying capacity to S24 and Tailteann was poorer than S 24 except in the first harvest year. The degree of superiority of S 23 and Reveille over the whole season is about 10% relative to S 24 and about 16% relative to Tailteann. Dry matter yield data over a period of two years obtained by frequent cutting of these four varieties in a separate experiment are presented in Table 3.

These results show that dry matter yield as measured by cutting is not a good guide to animal performance.

Seasonal differences

The varieties showed large differences in seasonal production and these are summarised in Table 4. The grazing season was divided into two periods : (1) April to July and (2) July to end of October.

Seasonal differences in stock carrying capacity of varieties relative to S 24=100

Table 4

Period 1 : 1st April - 7th July (approx.) — 100 days

Variety	1973	1974	1975*	1976	1977	1978
Tailteann	108	111	106	101	100	98
S 24	100	100	100	100	100	100
S 23	112	106	89	103	106	109
Reveille	111	122	113	112	112	115
Period 2 : July - end October (110 - 120 days)						
Tailteann	101	76	87	92	87	81
S 24	100	100	100	100	100	100
S 23	105	94	136	116	113	107
Reveille	104	85	105	106	94	89

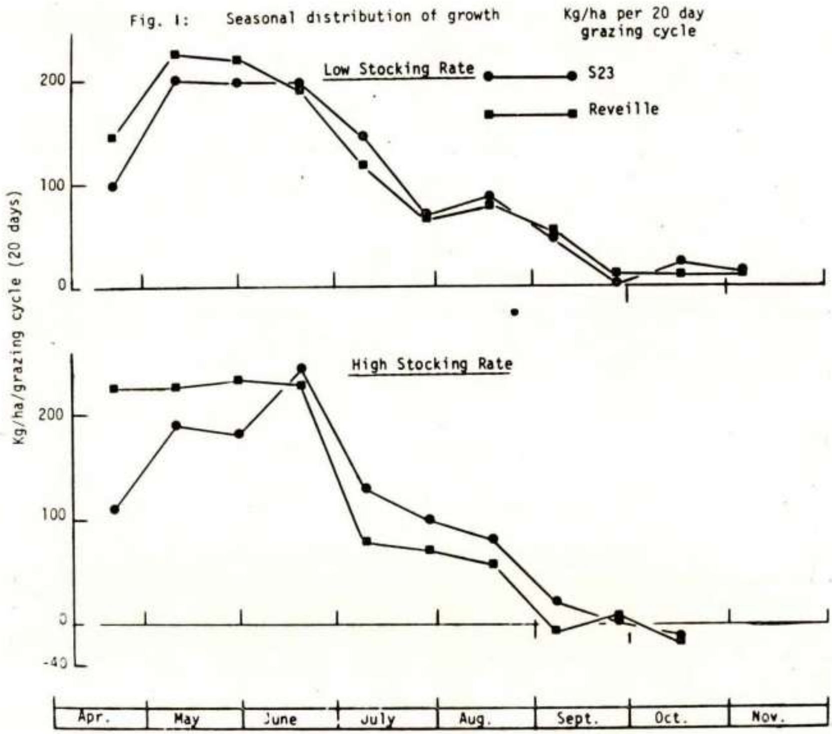
* In 1975 Period 1=80 days; stocking rate was reduced after four cycles of grazing because of drought conditions.

Future capital developments include the erection of extra cubicles for beef cattle, installation of cubicles in hayshed for extra yearlings and the extension of the slatted area for wintering sheep.

These results show that the stock carrying capacity of the tetraploid in the first period relative to all other varieties was very high. It is of interest to note that S 23 (a late variety) is better than S 24 (an early variety) in this period (with the exception of 1975 when the duration of Period 1 was shorter than usual). This was due to two factors:

(1) Period 1 covers the peak production of all varieties;
(2) S 24 is not nearly as good in terms of animal production in this early period as would be expected on the basis of dry matter yield data.

S 23 and Reveille produced similar total annual liveweight gains and the differences between these two varieties were mainly seasonal. The seasonal pattern of growth of these two varieties is shown in Fig. 1. The major disadvantage of S 23 is low production in the first 60 days after turn out while the main weakness of Reveille is low production in the July/August period.



Another aspect of seasonal productivity is summarised in Table 5. This shows the proportion of the total annual liveweight gain which was obtained in the period April - July (100 days). The results demonstrate the degree to which production is concentrated into this early period. Even for a late variety such as S 23, 75% or more of the total annual potential liveweight gain is obtained at this time.

Table 5

Average liveweight gain in the period 1st April - 7th July as % of annual gain

	Variety			
Stocking rate	Tailteann	S 24	S 23	Reveille
Low	80	75	75	76
Medium	89	81	76	83
High	93	84	82	87

Although the performance of S 23 was superior to the other varieties from mid-July onwards, the carrying capacity of all swards during this second part of the grazing season was low. The stocking rate reduction of 45% which was made at this time was not great enough to maintain liveweight per animal at a level comparable to that of Period 1 at all stocking levels.

Persistency

Table 6 summarises the persistency levels of the four varieties. These results were based on dry matter yield of the sward components.

As expected S 23 showed the highest persistency level. The tetraploid varieties are generally reputed to have low persistency levels. These data show that Reveille persisted well at all stocking rates and was equal to the values obtained for S 24.

Table 6

Botanical composition on dry matter basis

	Variety			
	Tailteann	S 24	S 23	Reveille
% Ryegrass				
Low	57	75	88	79
Medium	52	69	88	70
High	63	69	88	77
% White Clover				
Low	4.2	1.2	0.2	4.5
Medium	7.3	3.4	0.3	2.8
High	4.0	0.9	0.4	2.6
% Other Grasses				
Low	39	23	12	21
Medium	40	27	12	28
High	33	30	12	21

Summary

The data collected over six years show that pasture type as influenced by the sown variety has an effect on animal output. The results obtained here are restricted to a high nitrogen input system. In a low nitrogen system where greater reliance would be placed on clover then the superiority of S 23 is likely to decrease but the tetraploid would very likely retain its position because it is compatible with good clover growth. The results emphasise the high animal output capacity of some of the new tetraploid varieties. The data refer specifically to the earlier tetraploid perennial varieties such as Reveille. Greater use of such tetraploids in mixtures designed primarily for grazing or one silage cut plus grazing would seem desirable.

A Demonstration of High Beef Output on a Commercial Farm

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In 1974 a three year trial was initiated for the purpose of demonstrating the effects of stocking rate on beef output per acre. The trial was undertaken on part of E. Naughton's farm, in co-operation with the Advisory Service and Department of Agriculture.

The farm consists of 138 adjusted acres and the soil type is a heavy brown earth suitable for all livestock and tillage enterprises. Traditionally the farm in common with other farms in the vicinity was an extensive dry stock/sheep enterprise farm. Fertilizer application has been increased over the past 10 years and pH and soil fertility is currently being maintained at a high level.

Layout of trial

Cattle were stocked on the allocated areas at three different levels up to July when the stocking rates were reduced for the remainder of the grazing season. The details were as follows:

	Stocking Rate cwt/acre		
	Low	Medium	High
1974			
April 23-July 23	12	15	20
July 24 - November 1	12	13	14
1975			
April 21 - July 1	12	15	18
July 2 - November 1	12	13	13
1976			
April 14 - July 2	12	15	18
July 3 - November 4	12	13.5	13.5

Fertilizers

A basal dressing of 3 cwt. 0.10.20 per ace was applied in November. Application of nitrogen fertilizer consisted of:

2 cwt. 26% Net nitrate on all plots on March 1
1 cwt. 26% Net nitrate on all plots in June/July
1½ cwt. 26% Net nitrate on all 'High' plots in July
1 cwt. 26% Net nitrate on all plots in August/September

Results

Liveweight gains per animal and per acre are summarised in Tables 1 and 2. The results show that whilst the greatest liveweight gain per animal was achieved on the medium stocking rate, the highest gain per acre was obtained on the high stocking rate.

Table 1

Average liveweight gain per animal and per acre 1974-76

	Stocking rate		
	Low	Medium	High
Initial livewt., cwt.	6.3	6.2	6.3
Average daily gain, lb.	1.84	2.26	2.02
Livewt. gain/animal, cwt.	3.0	3.6	3.3
Livewt. gain/acre, cwt.	5.5	7.3	8.1

Table 2

Relative gain per animal and per acre

	Stocking rate		
	Low	Medium	High
Livewt. gain/animal	100	120	110
Livewt. gain/acre	100	133	147

It is concluded that intensive stocking is feasible on this farm, which is representative of the surrounding area, and that there is potential for a much greater volume of beef output per acre than that achieved in traditional practice. To realise this objective, the following management details are essential:

1. Rest pasture during winter.
2. Maintain soil fertility.
3. Apply N fertilizer six weeks before initial grazing.
4. Good grass swarth at time of cattle turnout.
5. Good fencing and water supply.

6. Rest paddocks before grazing.
7. Control of fluke and worms.

Farm development plan

The development plan, using experience gained from the stocking rate trial, is aimed at extending a high stocking rate over the whole farm. The development is phased as follows:

	1975	1977	1979	1980	1981
Suckler Cows	10	10	—	—	—
Cattle 0- 6 mths.	35	35	—	—	—
6-12 mths.	35	35	50	50	75
1- 2 y.o.	38	35	65	75	85
2-2½ y.o.	12	20	20	20	25
Breeding Ewes	111	120	120	140	160
Tillage—Beet	—	—	6	23	—
Barley	16	20	37	20	23
Feed Acres	132	128	105	105	125
Livestock Units	80.8	85.0	95.5	107.5	127
Stocking Rate	1.6	1.5	1.1	1.0	1.0.

The targets include the production of 85 beef cattle from weanling purchased 18 months earlier, the maintenance of 160 ewes by 1981 and a tillage rotation to provide the opportunity for establishing high yielding pastures.

For servicing this expansion in stock numbers the following capital programme has been implemented:

- erection of feeding, housing and slurry accommodation for 60 fattening cattle;
- cubicles, silo and slurry pit for 30 weanlings;
- covered slats for 100 ewes;
- farm roadway.

Reducing Winter Feed Costs in Beef Production

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The three most important factors which determine the profitability of fattening cattle in winter are:

1. Total feed costs.
2. Animal performance.
3. The autumn to spring cattle price increase.

The total non-feed cost of keeping a fattening animal for a 140 day winter period will vary with circumstances but for the present discussion a figure of £55 is taken. Included in this cost are total interest charges, repayments on building and other overhead costs, transport and marketing, mortality and dosing costs. It is appreciated that these costs may be substantially lower in many instances particularly when repayments on buildings do not apply.

Cattle price increases are likely to make smaller contributions to profits in the coming years than in the recent past and thus more emphasis will need to be placed on feed costs and animal performance. The effects of these two factors on returns are shown in Table 1 where the price increase is taken at only £5 per 100 kg. Using this price increase a daily gain of 0.7kg per day is required in order to break-even when total feed costs are as low as £50 for a 140 day winter period. The data show that high rate of gain and low feed costs are very important if profitability is to be maximised.

Table 1

Effect of feed costs and daily gains on returns (£) per animal

	Total feed costs per animal (140 days)		
Daily gains (kg)	£50	£70	£90
0.7	0	—20	—40
0.9	24	4	—15
1.1	48	28	8

Purchase price £80 per 100 kg
Sale price £85 per 100 kg

Chemical treatment of straw

Methods have been developed whereby the feeding value of straw can be improved by treating it with a chemical. Both sodium hydroxide and ammonia treatment methods have been investigated at Grange but no data are available on the latter method with fattening animals. The results of a trial in which fattening bulls (400 kg initially) were fed 5 kg concentrates (75% barley, 23% soyabean and 2% minerals/vitamins) per head daily and either untreated or sodium hydroxide treated barley straw to appetite is shown in Table 2.

Table 2

Effect of chemical treatment of straw on performance and feed intake

	Straw (plus 5 kg meals daily)	
	Untreated	Sodium hydroxide treated
Livewt. gain (kg) (187 days)	155	161
Carcass gain (kg)	83	104
Daily straw DM intake (kg)	5.3	5.6

Although there were only small differences between treatments in liveweight gains the killing-out percentages of animals fed the sodium hydroxide treated straw were significantly greater than when untreated straw was fed. Thus over 187-day feeding period carcass weight gains of animals fed untreated and treated straws were 85 and 104 kg respectively. Daily straw dry matter intakes were 5.3 and 5.6 kg for untreated and treated material respectively. The dry matter digestibility of untreated and treated straws were 45 and 61% respectively. While digestibility was improved as a result of treatment it should be noted that the final material was of relatively low feeding value. When the cost of treatment (about £20 per tonne of straw) and the increased straw intake are considered the increased gain from treatment is only about sufficient to meet the added costs.

Fodder beet roots

A number of experiments have been carried out in which pulped fodder beet roots were compared with barley as a supplement to grass silage for fattening cattle. The silages were fed to appetite in each experiment and were in general of high digestibility and properly preserved.

In six experiments, silage was fed alone to one group of animals and a second group was fed supplementary barley (2½ kg in four experiments and 5.0 kg in the other two experiments) with silage. Other treatment groups received a similar level of supplementary dry matter as an alternative to barley either as fodder beet alone or as fodder beet/soyabean meal. A summary of these experiments is presented in Tables 3 and 4. The results show that when fodder beet alone was fed the extra carcass produced was only 57 percent of that obtained from a similar level of supplementary barley dry matter. However, as a supplement to silage, fodder beet/soyabean meal gave additional carcass gains which were 91

Table 3

Extra carcass gain from feeding barley or fodder beet with silage

No. of experiments	Daily livewt. gain (kg)	Extra carcass gain (kg) from feeding	
	Silage only	Barley	Fodder beet
5	0.55	19.7	11.2

Table 4

Extra carcass gain from feeding barley or fodder beet/soyabean

No. of experiments	Daily livewt. gain (kg)	Extra carcass gain (kg) from feeding	
	Silage only	Barley	Fodder beet/ soyabean
5	0.55	25.9	23.6

percent those obtained from barley. The figures for feed intakes show that the depression in silage intake from the same quantity of supplementary dry matter was the same for the various supplements.

Molasses

At present prices molasses is a relatively cheap feed when compared with barley as a supplement for fattening animals fed high quality silage. For the purpose of the comparisons molasses was assumed to have an energy value 70 percent of that in barley. The supplements fed with silage were:

(1) 3.0 kg rolled barley.
(2) 4.3 kg molasses.
(3) 3.6 kg molasses plus 0.45 kg soyabean meal.

The results in Table 5 show that when additional protein was provided as soyabean meal the supplement of molasses gave carcass gains similar to that obtained from barley.

Table 5

Gains (kg in 85 days) of animals fed different supplements with silage

	Supplement (kg per head) daily)		
	Barley (3)	Molasses (4.3)	Molasses (3.6) Soyabean (0.45)
Liveweight	89	84	84
Carcass wt.	50.1	46.4	51.2

Information is lacking where molasses forms a higher proportion of the total diet and this aspect is at present being investigated.

Comparison of different diets for fattening cattle

In order to examine the possible role of fodder beet, molasses and treated straw in rations for fattening cattle, diets based on these feeds are compared. The usable yields and production costs of the various crops are shown in Table 6.

Table 6

Usable yields and production costs of various crops

	Tonnes DM per ac.	Costs (£/ac.)	Costs per tonne DM (£)	Costs per 1000 MJ ME (£)
Fodder beet	5.5	210	38	3.2
Barley—grain	1.7	80	47[1]	3.4[1]
—straw	1.0			
Silage	4.0	130	32	3.3

[1] grain only

This table shows that the high yield of fodder beet per acre offsets the higher production costs compared with barley and grass silage resulting in similar costs per unit of feed energy for the three crops. Three diets using different supplements with silage calculated to produce a daily gain of 0.9 kg per day in fattening cattle are presented in Table 7.

Table 7

Supplements fed with silage

Daily intakes (kg)	A. Barley (purchased)	B. Molasses	C. Fodder beet
Silage DM	7.0	7.0	3.5
Supplement	2.7	3.0	5.1[1]
Soyabean meal	—	0.46	0.68

[1] dry matter

A fourth diet based on sodium hydroxide treated straw (5.5 kg per day) and 5.5 kg concentrates (78% barley, 20% soyabean meal, 2% minerals/vitamins) per animal daily is compared with these in Table 8 in terms of feed costs and acres required per 100 cattle for a 140-day feeding period.

Table 8
Feed costs and acres required for 100 cattle (140 days)

	Diet based on			
	A. Barley[1]	B. Molasses	C. Fodder beet	D. Treated straw
Costs (£)	7,294	6,348	5,614	7,398
Acres	24.5	24.5	25.5	35.3

[1] Barley £110 per tonne   Molasses £55 per tonne   Soyabean meal £140 per tonne

Using diet A (based on silage and purchased barley) as standard, feed costs per animal is reduced by £9.50 per head as a result of replacing purchased barley by molasses/soyabean meal (diet B). The land requirements are similar for diets A and B. While the diet based on fodder beet is the most attractive, it must be remembered that production costs are high and these results are dependent on high yields per acre. Although the diet based on treated straw and concentrates is only slightly more expensive than diet A the acreage required is increased by almost 50 percent as all feed except soyabean meal is home produced and per acre production from barley is low.

The data illustrate the importance of (a) obtaining high yields of high quality material with home produced feed and (b) the feed cost per unit of digestible energy with purchased feeds.

Level of barley feeding with silage

The optimum level of barley for fattening cattle fed silage depends on a number of factors. To estimate this level a brief summary of feeding experiments carried out at Grange is now presented and economic returns are calculated, using various winter cattle price increases and barley prices.

Table 9
Effects of feeding barley with silage on 140-day gains and on silage intakes

	Barley fed (kg per head daily)		
	0	1.8 (4 lb)	3.6 (8 lb)
Livewt. gain (kg)	79	116	132
Carcass gain (kg)	41	64	77
Daily silage intake (kg)	7.3	6.5	5.9

The data presented in Table 9 are the average results from a number of experiments in which cattle were fed grass silage alone or with different levels of supplementary barley. The responses from feeding 1.8 and 3.6 kg of barley per animal daily were then calculated and adjusted to a 140-day feeding period. The responses are shown in Table 10.

Table 10

Responses from barley feeding (kg barley per kg gain)

	1st 1.8 kg barley (0 to 1.8)	2nd 1.8 kg barley (1.8 to 3.6)
Liveweight	7.0	15.1
Carcass weight	10.9	20.0

The average daily liveweight gain of animals fed silage alone was 0.57 kg which demonstrates that moderate to high quality silages were used in these studies. When calculated over a 140-day feeding period, animals fed 1.8 and 3.6 kg barley daily gained 23 and 36 kg more carcass weight than those fed silage alone. Feeding 1.8 and 3.6 kg barley daily depressed silage intakes by 10.0 and 18.5 percent respectively. A good response in terms of animal performance was obtained from feeding the first 1.8 kg of barley daily but increasing the levels of supplementation from 1.8 to 3.6 kg resulted in a major decline in the liveweight and carcass weight responses to supplementation.

Table 11

Financial returns from feeding silage alone (600 tonnes—100 animals)

	Purchase price (£/100 kg)	
Selling price (£/100 kg)	75	80
80	−1999	−1047
85	269	−1779
90	2537	489

From these results, the financial returns were calculated for a farm example involving a winter feeding period of 140-days where 600 tonnes silage are available. The number of cattle (400 kg initially) which can be carried for 140 days is 100, 111 and 123 where 0, 1.8 and 3.6 kg of barley are fed respectively.

In order to place the returns to barley feeding in their proper prospective, the financial returns from feeding silage alone are shown in Table 11 using various purchase and selling prices. As used here, financial return means the difference between the sale price of animals and cost of animals, housing, dosing etc., including the interest on money invested in these items where this is applicable. A charge for labour is not included in the costs. This table shows that when silage only is fed, a winter cattle price increase of £8 to £9 per 100 kg. is required to break-even. The price increase required to break-even would be greater at lower levels of production. The extra returns obtained from feeding 1.8 and 3.6 kg of barley per head daily with silage are shown in Table 12 when barley is charged at £105 per tonne.

Table 12

Extra returns (£) from feeding barley (£105/t) with silage (600 tonnes)

Winter price increase (£/100 kg)	Barley fed (kg per head daily)	
	1.8 (111 animals)	3.6 (123 animals)
0	1164	629
5	1653	1562
10	2142	2495
Purchase price £80 per 100 kg		

The extra returns from meal feeding is the difference between that obtained when barley is fed and that obtained when silage alone is fed. No charge is made for additional housing where extra cattle are carried as a result of meal feeding because it is assumed that adequate housing is available.

Although feed costs per animal are £43, £65 and £88 where 0, 1.8 and 3.6 kg of barley are fed respectively economic returns are improved in all instances from barley feeding. This improvement in returns illustrates the importance of the increased rates of gain obtained from feeding barley. The optimum level of barley depends on the cattle price increase, with 3.6 kg only proving as economical as 1.8 kg when the price increase is over £5 per 100 kg. However, if barley is charged at £125 per tonne (Table 13) an extremely high price increase is required in order to justify the feeding of 3.6 kg barley per animal daily.

Table 13

Extra returns (£) from feeding barley (£125/t) with silage (600 tonnes)

Winter price increase (£/100 kg)	Barley fed (kg per head daily)	
	1.8 (111 animals)	3.6 (123 animals)
0	600	—621
5	1089	312
10	1579	1245
Purchase price £80 per 100 kg		

This shows that the cost of barley becomes increasingly important as the level of barley feeding is increased. As interest charges are included in the cost of barley and considering the expected price for finished cattle in spring the optimum level of barley will be about 1.8 kg in many cases. It should be noted however that the above figures do not include the advantages expected from growth promoters which substanially improve returns in all instances as shown in Table 14.

Table 14

Financial returns (£) from feeding 600 tonnes silage with and without growth promoters

	Barley fed (kg per day)		
	0	1.8	3.6
No growth promoters	−1779	−126	−217
Plus growth promoters	221	2094	2243
Purchase price £80/100 kg	Sale price £85/100 kg		

In this table it is assumed that returns are improved by £20 per animal as a result of the growth promoters.

Conclusions

Apart from cattle price increases the most important factors to consider in obtaining good returns from winter fattening are:

1. High animal performance.
2. High yields per acre of high quality material as illustrated by fodder beet.
3. Low cost per unit of feed energy for purchased feeds.

The Use of Growth Promoters in Beef Cattle

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Growth rate of animals is affected by many factors such as previous and present plane of nutrition, sex of animal, breed, environment, season and health status. Bulls will grow faster than steers, steers grow faster than heifers and removal of the ovaries from heifers further depresses growth rate. The effects of sex on growth rate are mediated through hormonal effects.

Because of the known effects of hormones on growth rate, various growth promoting implants have been developed. These can be classified generally as follows:

1. Oestrogens—female sex hormone—the manufacture, preparation, packing or sale of any animal remedy containing oestrogen to which the regulations apply is prohibited, save under licence of the Minister for Agriculture. Synovex-S is the most common one used in the U.K. This product contains progesterone and oestradiol and it has recently become available commercially in Ireland through veterinary surgeons.
2. Androgens—male sex hormones—these are similar in action to testosterone which is present in bulls and trenbolone acetate (Finaplix) is the one most commonly used.
3. Non-hormonal compounds—simple chemicals—affect growth rate and resorcylic acid lactone (Ralgro) is the most common one used in this category.

The commercially available growth promoters in Ireland at present are shown in Table 1.

Side effects

Ralgro or Finaplix have shown no undesirable side effects following use, such as abnormal behaviour, raised tail head, lactation in males etc. If Finaplix was repeatedly used, it is possible that some male behavioural characteristics would develop. These two compounds when used properly are safe to animal and man.

Some side effects have been reported on the use of growth promoters containing oestrogens (Synovex) such as increase in mounting, riding, increased aggression and raised tail heads. At time of insertion of implants, it is important that they are not crushed or inserted on wet days because there can be a greater release rate from the implant resulting in worse problems. In addition, it is important not to mix implanted cattle with strange cattle as this can trigger off fresh behavioural problems.

Table 1

Available growth promoters in Ireland

Compound	Abnormal behaviour	Cost (£)	Where available	How to administer	Male or female effect
Finaplix	None	1.50	Vet	Ear implant	Male
Ralgro	None	1.10	Chemist, Co-op, Vets	Ear implant	Female
Synovex-S (steers)	Bulling, mounting, udder development	1.50	Vet	Ear implant	Female
Synovex-H	Bulling, mounting, udder development	1.50	Vet	Ear implant	Female
Romensin	None	1p/day	Feed Compounders	Feed additive	Antibiotic

Mechanism of action

Growth promoters generally increase tissue growth and particularly muscle growth at the expense of fat. There appear to be different mechanisms of action.

(i) Direct action of the compound in the target tissue. The hormone binds to a receptor in the cell, thereby initiating a series of reactions which result in increases in DNA synthesis. Androgens work in this fashion (Finaplix).

(ii) Indirect action on the brain and pituitary gland resulting in increased release of growth hormone. Growth hormone then acts on target tissue as just described to increase protein synthesis. Ralgro and oestrogens appear to work in this manner.

The net result is an increase in nitrogen retention in the tissue and a decrease in urinary excretion rate of nitrogen. Thus, these compounds work more by increasing efficiency of conversion of food into muscle than by increasing feed intake.

Use of either compound once

It is claimed that either Ralgro or Finaplix will increase growth rate and feed efficiency in animals on pasture or fed on roughage and concentrate diets. Experiments have been carried out at Grange and Ballinalack on finishing steers and results to date for Ralgro are summarized in Table 2 and for Finaplix in Table 3. Ralgro significantly increased the mean liveweight gain. There was variation in liveweight gain from trial to trial of the order of 0 to 20% increase with an average increase of 10%. Carcass weight was also increased by a mean of 7 kg. over controls.

Table 2

Effect of Ralgro on daily liveweight and carcass gain in finishing steers

Treatment	N. of steers	Length of exp. (days)	Final livewt. (kg)	Daily livewt. gain (kg)	Carcass wt. (kg)
Control	106	78-160	554 ± 3.7	$0.61 \pm .019$	311 ± 2.28
Ralgro	140		575 ± 3.4	$0.74 \pm .017$[1]	318 ± 2.09

[1] Difference significant ($P<0.05$)

Experiments with Finaplix show no significant increase in liveweight gain although the percent increase varied from 9 to 20% with a mean of 14% increase over controls. Likewise, mean carcass weight was increased by 6 kg. over controls in these trials.

Table 3

Effect of Finaplix on daily liveweight and carcass gain in finishing steers.

Treatment	No. of steers	Period (days)	Final livewt. (kg)	Daily livewt. gain (kg)	Carcass wt. (kg)
Control	75	65-80	488.5 ± 3.4	$0.60 \pm .023$	259 ± 1.97
Finaplix	75		494.2 ± 3.4	$0.65 \pm .023$[1]	264 ± 1.98[1]

[1] Difference not significant

Repeated use of Ralgro

Trials were carried out to determine if a second implant of Ralgro 60 days after the first will give a further increase in performance. Five hundred and sixteen animals on four farms, mainly Friesian X, were allocated to three groups: (1) untreated, (2) Ralgro at start of experiment and (3) Ralgro at start and repeated after 60 days. The minimum length of treatment on any farm was 130 days.

Table 4

Effects of repeating the use of Ralgro on performance in steers.

Treatment	No. of animals	Initial livewt. (kg)	Final livewt. (kg)	Daily livewt. gain (kg)	Carcass wt. (kg)
Control	173	483	556	0.586	299
Ralgro once	171	482	569	0.697	307
Ralgro twice	172	484	574	0.721	311
S.E. of mean	—	2.7	3.4	0.014	2.0

There was variation from farm to farm but from the above results in Table 4 it does not appear worthwhile to re-use Ralgro 60 days after the first implantation. Whether or not a response would be obtained to the second implant if a longer interval was used has not been tested.

Trials were carried out in the winter of 1975 on 815 finishing beef steers fed on silage and concentrates to determine if either implant alone or if both together would affect daily liveweight gain and carcass weight. The animals were allocated at random into four groups:

Group 1: Untreated controls.

Group 2: Ralgro given at start of experiment.

Group 3: Finaplix given about 30 days after start of experiment.

Group 4: Combination treatment of Ralgro initially followed by Finaplix in about 30 days.

Animals were weighed throughout the experiment and the mean and daily liveweight gains are given in Table 5. Either growth promoter alone gave a significant increase in growth rate. The combination treatment gave a further additive increase in growth rate over either compound used alone and this was significant. Carcass weights were available for 596 animals on two farms and the mean carcass weights for groups 1, 2, 3 and 4 respectively were 310 ± 2.05, 319 ± 2.01, 316 ± 2.01 and 328 ± 2.04. Animals on the first farm were slaughtered after 98 days and after 135 days on the second farm. Again significant increases in carcass weights over 'controls' for either compound were obtained and the combination treatment gave a further significant increase.

Table 5

Performance of steers following Ralgro or Finaplix alone or combined

Treatment	No. of steers	Final livewt. (kg)	Daily livewt. gain	Carcass wt. (kg)
From time of Ralgro insertion to end				
Control	204	560	0.58	310
Ralgro	216	572	0.75	319
Ralgro + Finaplix	208	590	0.85	328
From time of Finaplix insertion to end				
Control	204	560	0.49	310
Finaplix	187	508	0.61	316
S.E. of mean		3.0	0.015	

Can Ralgro and Finaplix be inserted on the same day?

A trial was conducted to determine whether it was necessary when using the combination of Ralgro and Finaplix to wait 30 days before inserting Finaplix. There were 423 animals on two farms allocated at random to 3 groups:

(1) Control group.
(2) Implanted with Ralgro at start of experiment followed in about 30 days by Finaplix.
(3) Implanted with both Ralgro and Finaplix at start of the experiment.

There was a significant ($P<0.01$) increase in final liveweight and daily liveweight gain of steers treated with growth promoters compared with controls (Table 6). Animals were slaughtered after mean duration of 132 days. There was also a significant ($P<0.001$) increase in carcass weight of treated steers compared with controls. There was no difference in final liveweight gain or carcass weight for steers receiving both compounds on the same or different days. Thus, both compounds can be inserted on the same day and still get the same effect as inserting them 30 days apart.

Table 6

Effect of insertion of Ralgro and Finaplix at start of experiment or separated by about 30 days on performance of finishing steers

Treatment	No. of animals	Initial livewt.	Final livewt.	Daily livewt. gain	Initial wt.	Carcass wt.
Control	141	514	575	0.467	515	312
Ralgro + Finaplix together	141	519	610	0.702	519	330
Ralgro + Finaplix separately	141	516	611	0.728	517	330
S.E. of mean	—	3.3	3.9	0.013	3.4	2.24

Repeated use of Ralgro and Finaplix

A trial was carried out to determine if re-implanting steers 65-70 days later with Ralgro and Finaplix further increased growth rate compared to steers given the combination treatment once. There were 453 animals on three farms allocated at random to three groups:

(i) Control.
(ii) Implanted with Ralgro and Finaplix at start of experiment.
(iii) Implanted with Ralgro and Finaplix at start of experiment and re-implanted with Ralgro and Finaplix 65-70 days later.

Re-implantation 65-70 days after initial implantation significantly increased final liveweight, daily liveweight gain and carcass weight compared to steers given the combination treatment once (Table 7). This treatment should only be considered where animals are being kept for at least 130 days and are on a high plane of nutrition from start of treatment.

Table 7

Repeated use of Ralgro + Finaplix

Treatment	No. of animals	Initial livewt.	Final livewt.	Daily livewt. gain	Carcass wt.
Control	151	498	589	0.55	315
Ralgro + Finaplix—once	154	501	613	0.70	327
Ralgro + Finaplix twice	148	492	632	0.81	338
L.S.D.		8.8	6.5	0.038	4.0

Effectiveness at pasture

The purpose of the next experiment was to determine whether results being achieved on silage and concentrates over the winter months could be obtained when animals were on pasture. At the start of the experiment, all implants were inserted into the base of the ear.

Either growth promoter when used alone significantly ($P < 0.05$) increased final liveweight and daily liveweight gain (Table 8). Resorcylic acid significantly ($P < 0.01$) increased carcass weight but trenbolone acetate did not. The reason for this discrepancy is not clear. The use of both growth promoters again gave significant ($P<0.01$) increase in final liveweight, daily liveweight gain and carcass weight compared either with both compounds used alone or compared with performance of control steers.

Table 8

Effect of Ralgro or Finaplix alone or combined on steer performance at pasture

Treatment	No. of animals	Initial livewt.	Final livewt.	Daily livewt. gain	Carcass wt.
Control	79	454	566	1.21	315
Ralgro	80	456	582	1.38	321
Finaplix	80	455	576	1.32	318
Ralgro + Finaplix	79	454	596	1.57	329
S.E. of difference between means	—	6.8	7.0	0.04	2.5

Use in female cattle

In contrast to the results in steers, the results in heifers or cull cows are not as clear and can be summarized as follows:

(1) Marginal response obtained.

(2) Ralgro and Finaplix not additive.
(3) Finaplix is the implant recommended.
(4) Monensin could also be considered for use as a feed additive.

Use in calves and weanlings

Ralgro is the growth promoter one would consider using in calves. Two trials have been carried out to date in uncastrated calves from 3-5 months of age. Calves in Trial 1 were Friesian bull calves while those in Trial 2 were multiple suckled Friesian or Charolais cross animals. The liveweight gain of control and Ralgro treated animals respectively were 57.5 ± 1.9, 60.9 ± 1.9 in Trial 1 and 89.7 ± 1.9 and 86.6 ± 1.9 in Trial 2. No increase in daily liveweight gain was obtained in these trials with bull calves. However, in other trials with steer calves we have got a 10-15% increase in growth rate in calves varying in age from ten days to four months.

Table 9

Feed intake and carcass composition of steers fed on silage and concentrates and given different anabolic compounds

	Control	Romensin	Ralgro + Finaplix	Ralgro + Finaplix + Romensin
Total L.wt. gain	101	115	132	129
Carcass gain	58	64	78	76
Silage DM intake/day	6.5	6.6	6.7	6.7
Mean wt. of cold side	148	152	137	156
Mean wt. of lean cuts	100	102	109	106
Mean wt. of fat trim	21	24	21	22
Mean wt. of bone	27	26	27	28

One trial has been carried out in Ballinalack on 8-9 month old Friesian bulls with Ralgro. Animals were allocated at random to two groups of 26 each: (1) untreated control and (2) treated with Ralgro. The initial and final liveweights after 88 days were 189 and 222 kg. for control weanlings and 191 and 225 kg. for weanlings given Ralgro. From these limited trials with *uncastrated* calves or weanlings, no effect of Ralgro on liveweight gain was obtained.

Feed intake

Experiments have been carried out in Grange to determine whether implanted steers have a parallel increase in feed intake in relation to increased level of weight gain. Either Ralgro or Ralgro + Finaplix increased feed intake by 2-4%. Thus, growth promoters work mainly by increasing conversion of feed into meat.

Carcass composition

The results of commercial vacuum pack cutting for estimating the weights of lean meat, fat trim and bone are shown in Table 9. The increase in carcass weight following Ralgro and Finaplix is mainly lean meat, a result similar to that in bulls. In contrast, there is the normal increase in fat and lean in the carcass following Romensin, a situation comparable to that in steers given more energy.

Possible combinations to use

In steers the following combinations can be used:

1. Female + male growth promoters: the two are additive for example, Ralgro + Finaplix, Synovex + Finaplix.
2. A growth promoter + feed additive: the two are additive for example, Ralgro + Romensin, Synovex + Romensin.
3. Female + male growth promoter + feed additive: the three are not additive to date, for example, Ralgro + Finaplix + Romensin.

In female cattle Relgro + Finaplix are not additive; use either Finaplix or Romensin.

Factors affecting response to growth promoters

Response is affected by plane of nutrition and animals should be gaining at least 0.5 kg per day in order to get a good response from growth promoters. Where animals gained less than 0.25 kg. per day, the response was very poor. Therefore, growth promoters can be used on finishing cattle fed on good quality silage and concentrates or in animals turned out to grass from April to July. MLC results from the U.K. indicate that the best growth responses were obtained in animals which were implanted at turnout to grass in spring. Response is also affected by sex; it is clear from the data that steers show larger responses than heifers or cull cows. It is also clear that in order to achieve maximum response cattle must be free of endo and ectoparasites.

Residues of growth promoters

Many of the anabolic compounds used in animal production have the effect of altering the levels of the natural growth hormones in the animal. Natural hormones are safe to use provided that levels in blood and tissue do not exceed the normal levels found under a variety of physiological situations.

Synovex-S implants increased the levels of oestradiol 17 beta in plasma after implantation. Levels were still raised 60 days after implantation but by 120 days the levels were similar to that in non-implanted steers. Finaplix residues of trenbolone acetate have been found in various tissues 63 days after implantation in amounts similar or lower than normal levels of testosterone in bulls. Ralgro is absorbed slowly at a fairly constant rate from the implants. Using tritium labelled resorcylic acid safe amounts of residues were found in muscle, liver, kidney and fat 65 days after implantation.

Limitations

1. Animals must not be slaughtered for 60-65 days after implantation in order to ensure that residues are low or undetectable in meat.
2. Breeding males or females must not be treated with hormonal type growth promoters.
3. Insert implants in the ear only as there is a residual amount of compound at the site of implantation for many months. Since the ear is disposed of, this does not create any hazard.
4. There is variation from farm to farm in response obtained.
5. Fluctuations in beef prices should be borne in mind when deciding to use implants. If beef prices suddenly decline treated cattle should not be sold until the recommended withdrawal period has elapsed.

The Ralgro + Finaplik combination is effective for about 120-130 days. Thereafter, the animals will gain weight at the normal rate. The only limitation on date of slaughter is to ensure that the recommended withdrawal period has elapsed.

Conclusions

Growth promoters produce an economic response in steers but they must be used properly. In finishing beef cattle the use of growth promoters is one effective way to improve profitability. Thus, every effort must be made to ensure that this aid remains available to beef producers by proper use of the compounds.

Gabriele Lüttmann, Amsterdam Strasse 2, Düsseldorf.

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She likes Kerrygold butter and cheese because they have a country fresh taste.

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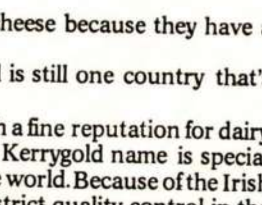

Irish International

Recent Developments in Dairy Cow Nutrition

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The major ingredients of the dairy cow's diet are grass (60%), silage (30%) and concentrates (10%). The importance of silage quality, quantity and good preservation was discussed by the author in this Journal in 1978, Volume 13, page 65. This paper describes in more detail the use of concentrates in the diet of the dairy cow. In addition the age and weight at first calving of heifers are discussed.

Energy content of the diet

Presently many feeds for ruminants are expressed as Mega Joules (M.J.) of Metabolisable Energy (M.E.) per kilogram of dry matter. From these values the energy content of the diet can be determined. Most publications only contain a mean value of the individual feed ingredients. However, great variations can occur.

The energy value of the formulated diet is influenced by the oil content, fibre level, ash and dry matter content of the ration. High fibre values will reduce the feeding value as will high levels of ash and moisture in the diet. Increasing the oil level will tend to increase the energy value of the ration. Fats or oils contain a high gross energy level (approximately 39 M.J./kg) as compared with protein or carbohydrate (approximately 17.1 M.J./kg) and the feeding of fat or oil is a potential method of increasing energy intake. High energy diets are essential for high yielding cows in early lactation due to their low intake capacity at this time. Fat or oils can be fed in either protected or unprotected form. The purpose of protecting the fat is to reduce the breakdown of fat in the rumen. The protection is achieved by encapsulating the fat droplet in a layer of aldehyde treated protein. The research findings on feeding unprotected fat are variable. In general data suggest that with roughage diets the effect of high inclusion of fat in the diet does not give increased output of milk.

The effect of tallow added to a concentrate diet was studied at Moorepark. A preparation containing tallow and protein (75 : 25) was prepared as a fine mix and a ration formulated to contain 9% oil in the concentrate was compared with a control ration containing 3.75% oil.

Thirty spring calving cows were fed al libitum silage plus 7.25 kg of a 16% protein ration for a three week preliminary period after calving and were then assigned to either of three treatments for an eight week experimental period as follows:

(1) Ad libitum silage plus 7.25 kg of dairy ration (18% CP) normal energy.

(2) Ad libitum silage plus 7.25 kg of dairy ration (18% CP) including added fat (high energy).

(3) Ad libitum silage plus 6.6 kg of dairy ration (18% CP) including added fat but energy intake of the concentrate is equalised to the level of treatment 1. The composition of the dairy rations are shown in Table 1 and the chemical composition in Table 2.

Table 1

Percentage composition of the rations

Ingredients	Control ration	High energy ration
Soya bean meal	10	10
Ground nut	11.2	13.3
Maize	37.8	31.45
Barley	23.75	19.0
Molasses	5.0	5.0
Meat and bone	5.0	5.0
Tallow	2.0	2.0
Premix (6.7%)		9.0
Minerals and vitamins	5.25	5.25

Table 2

Chemical composition of the concentrate rations

	Control ration	High energy ration
Crude protein %	17.9	17.5
Oil %	3.7	8.9
Crude fibre %	3.3	3.0
Ash %	7.7	7.8
DM %	89.9	90.3
Energy concentration (M.J./kg DM)	12.8	13.8

Both rations were of good quality, low in fibre and ash and high in dry matter concentration. The energy density of both rations was high, 11.5 M.J./kg as fed for the control and 12.5 M.J./kg for the high energy ration.

The results are presented in Table 3. Group A, receiving 7.25 kg of the control ration, had a similar performance to Group C, receiving 6.60 kg of the high energy ration, in milk yield, fat yield, protein yield, fat %, protein % and liveweight changes. Group B receiving 7.25 kg of the high energy ration produced significantly more milk than Group C and also more fat and protein. There was no significant difference between A and

B in any of the parameters measured. A digestibility trial was carried out in conjunction with the experiment but there were no differences in the digestibility of the dry matter, energy or fibre on any of the 3 diets.

Table 3

Concentrate type and cow performance

Ration type Level of feeding (kg/cow/day)	Control 7.25	High energy 7.25	High energy 6.60
Milk yield (kg/day)	20.14	21.28	19.88
Fat %	3.84	3.89	3.78
Protein %	2.85	2.83	2.82
Silage DM intake as % bodyweight	1.58	1.74	1.81
Bodyweight changes (kg/day)	0.11	−0.16	0.17

The results of this trial would not justify the inclusion of tallow at high levels in dairy rations to increase energy density. It must be noted that the control ration was of high quality and possibly greater differences might occur if this were not so. The results emphasize that it is possible to formulate high quality rations with normal ingredients, available to the compounding industry without resorting to the inclusion of high fat levels in the diet which may cause digestive upsets and reduced digestibility of the diet. The form of the added fat or oil may also be important but the best responses obtained from the addition of high levels of fat or oil in the diet is when they are protected by the addition of aldehyde treated protein to encapsulate the fat droplets.

The protein content of dairy rations

The two major components in concentrate rations are energy and protein, but minerals and vitamins are also included. There is little critical information available on nutritive value of silage protein and on protein supplementation of grass silage. In many silages, 50% of the crude protein is composed of non-protein nitrogen. Under such circumstances, although the crude protein intake of the cow maybe theoretically adequate, there maybe a response to additional protein. In two feeding trials at Moorepark involving 180 individually fed cows, the effect of varying the protein content of the concentrate was examined with average and poor quality silage as the basal feeds. Concentrates were formulated to contain three levels of protein (12, 15 and 18%) and were fed at 3.0, 5.5 and 8.0 kg per day to nine groups of cows with each silage. The concentrates were composed of barley and soyabean, and contained 2% mineral vitamin mixture. The experimental feeding period in early lactation was eight weeks, and cows then uniformally treated on pasture for 12 weeks. In Table 4 the milk yields for the eight week experimental period and for the period 1-20 weeks are presented and in addition the margins over concentrate costs are also shown. The price of the concentrates was adjusted in relation to the crude protein concentrations in the diet. The results indicate that there is little response to protein at the low level of feeding. However, when the feeding levels increased to the 5.5 and 8 kg per day there was a response in all cases from 12 to 15% crude protein and only at the higher feeding levels was there a response from going from 15 to 18% crude protein. The results presented in Table 4 are data from one of the silages fed in this experiment. When the results of both experiments are examined it is concluded that a feeding level of 7 kg a day at 16% crude protein is the most economic at the present feed price-milk ratio. However, if feeding levels exceed 8 kg a day it maybe beneficial to increase the level of protein to 18%. The data further suggest, particularly in the eight week experimental period, an inter-changeability between energy and protein. This is illustrated when the feeding level of 5.5 kg per day at 18% crude protein is compared with the 8 kg feeding level at 12% protein where similar milk production was obtained for both groups. This result occured in both experiments. The protein content of a concentrate had no effect on silage intake. As the level of concentrate feeding increased the intake of silage was significantly decreased. Liveweight changes during the eight week experimental period reflected the level of feeding with greater body weight loss occuring at the lower feeding levels. Milk fat and milk protein percentages were not affected by the level of protein in the concentrate. As would be expected, milk protein percentage increased with the level of concentrate feeding.

Table 4

Effect of concentrate protein content on milk production

Feeding level (kg/day)	Crude protein (%)	Milk yield (gal.) 1-8 weeks	Margin over concentrates (£)	Milk yield (gal.) 1-20 weeks	Margin over concentrates (£)
	12	151	57	425	200
3.0	15	152	57	400	186
	18	154	57	405	188
	12	173	50	424	181
5.5	15	182	54	469	204
	18	187	55	457	197
	12	186	39	438	171
8.0	15	192	41	455	179
	18	207	48	481	190

Flat versus variable feeding levels of concentrates to spring calving dairy cows

There is much discussion at the present time on the methods of feeding concentrates to dairy cows. This mainly arises from the higher milk yields presently been obtained on many dairy farms. Many people conclude that with higher yields it is necessary to allocate the concentrates in relation to yield. This has resulted in the installation of feeders into many milking parlours to allow allocation of concentrates in relation to yield. The inclusion of feeders in parlours may be for the purpose of overcoming the problems of handling large quantities of concentrates for dairy herds. An experiment has been carried out at Moorepark comparing the feeding of fixed levels of concentrates to lactating cows with varying concentrate feeding levels in relation to yields. One group of cows was fed 7.3 kg of concentrates per cow per day for an eight week period while a second group was fed the same total quantity of concentrates but allocated to each cow in proportion to her yield. The milk yields of the cows in each group varied between 3½ to 6 gallons at the initiation of the experiment. The results of the experiment are presented in Table 5.

Table 5

A comparison of flat rate and variable rate concentrate feeding levels for dairy cows

	Flat rate feeding	Variable rate feeding
Average concentrates (kg/cow)	407	407
Milk yield (kg/cow)	19.5	19.5
Miilk fat %	3.86	3.75
Milk protein %	3.10	3.08
Silage dry matter intake as percent of bodyweight	1.61	1.40
Liveweight change (kg/day)	0.06	−0.32

The results indicate that there was no significant difference in milk yields or milk composition for either treatment. It can be concluded from this experiment that provided there is no undue competition for concentrates at the feeding trough there is no nutritional justification for including expensive methods of feeding in dairy farming. Close examination of the data show that those cows on the variable feeding rate receiving the higher levels of feed reduced their silage intake as the level of concentrates increased, and similarly those on the lower feeding levels tended to eat more silage.

Age and weight at first calving

Due to the seasonal calving nature of the Irish Dairy Industry heifers entering the dairy herd calve at two or three years of age. The effect of both age and weight at first calving is being studied at the Agricultural Institute Field Station, Ballyragget, Co. Kilkenny. Friesian spring calving heifers have been divided into four treatment groups to compare the effect of weight at first calving on lactation performance. Two groups had a target weight of 450 kg weight before calving and were stocked at 0.95 and 0.75 acres per animal after calving. The other two groups were also stocked at 0.95 or 0.75 and had a target weight of 525 kg before calving. These stocking rates provide grazing and silage requirements. Three year old calving heifers were also stocked at either 0.95 and 0.75 animals per acre and had a pre-calving weight of 565 kg. The two year old calvers completed three lactations by the end of 1978 and the three year olds have completed two lactations. For ease of presentation the stocking rate groups are combined and the results are summarised in Table 6.

Table 6

Effect of age and weight at first calving.

Pre calving weight (kg)	Age (years)	Milk yields (gal.)			
		1976	1977	1978	Total
450	2	555	595	726	1876
525	2	684	582	704	1970
565	3	—	641	694	1335
		Pre calving weights (kg)			
		1976	1977	1978	
450	2	450	478	596	
525	2	525	507	630	
565	3	—	565	627	

In the first lactation the two year olds weighing 525 kg produced substantially more milk than two year olds calving at 450 kg. During the summer and autumn of 1976 feed supplies were scarce and these animals had little opportunity to gain weight between the first and second lactations, and their pre-calving weight in 1977 differed very little from their pre-calving weight in 1976. This resulted in a disappointing milk performance during 1977. However during that period the animals increased substantially in body-weight as indicated by their pre-calving weight at the start of 1978. The milk production performance in 1978 increased substantially over the 1977 figures. To date the heavier two year old calvers have over a 100 gallons more milk produced at the end of the third lactation. Delaying calving to three years of age did not greatly improve the milk lactation performance in the first lactation. Modest milk increases between first and second lactation were recorded for these three year old calving heifers even though they did increase in weight between first and second lactations. The two and three year old calvers were born in the same year but the milk production at the end of 1978 shows that the three year old calvers have 600 gallons less milk produced than the two year calvers to date. The early indications are that two year olds at the heavier weights (525 kg) have a lower culling rate than either of the other two groups. While this experiment is still in progress one could indicate that the pre-calving target weight for heifers should be over 500 kg calving at two years and there is little advantage to be gained in delaying calving to three years of age if the heifers are well grown as two year olds.

The effect of level of concentrate feeding to dairy cows on a whole farm system basis

An experiment to study the effect of pre- and post-calving feeding levels of concentrates to dairy cows on a whole farm system basis is presently in progress at the Agricultural Institute Field Station, Solohead, Co. Tipperary. There are four treatment groups: herds A and B are stocked at 1.17 acres per cow and herds C and D at 0.96 acres per cow. Herds A and C are fed 2.7 kg of concentrates daily to all heifers and first lactation animals in the prepartum feeding period. Post-calving feeding levels for these groups amount to 5.5 kg of concentrates daily to all animals from calving until March 31st; and 2.7 kg thereafter until the middle of May. All cows in herds B and D are fed 2.7 kg of concentrates per day in the pre-calving period which commences in late November. These two groups of cows are fed 9 kg of concentrates post-calving until March 31st and are then reduced to 4.5 kg daily until the middle of May. The first years results (1978) are presented in Table 7.

Table 7

Effect of pre and post calving concentrate feeding level and stocking rate on cow performance — Solohead (1978)

	Treatment			
	A	B	C	D
Stocking rate (ac/cow)	1.17	1.17	0.96	0.96
Concentrates (kg/cow)	475	860	490	750
Milk yield (gal/cow)	771	761	697	740
Margin over concentrates (£)	338	284	298	288

The low meal groups A and C were fed less than 500 kg of the concentrates per cow and the high meal feeding groups B and D had an intake of 860 kg and 750 kg of concentrates respectively. There was no response to increased concentrate feeding levels at the low stocking rate and there was an advantage of 43 gallons at the higher stocking rates. When one studies the margin over concentrates there was no economic advantage to feeding the higher levels of feeding at either the low or high stocking rates. This is the first year of this experiment and therefore the results must be treated with caution but they do indicate that care must be taken that excessive amounts of concentrates are not fed to spring calving cows resulting in reduced profitability on the farm.

A similar type of experiment is in progress at Moorepark where the concentrate feeding levels post-calving over the entire grazing season are being studied. The experiment involves four experimental groups: Groups A and B are stocked at 1 cow per acre for the entire season and C and D are stocked at 0.8 acres per cow. Groups A and C are fed the lower levels of concentrates approximately 500 kg per cow and Group D and B are fed higher concentrate feeding levels amounting to approximately one tonne over the total lactations. Groups A and C are fed 7.3 kg of concentrates per day post-calving until the middle of April when meal feeding ceases with the exception of 0.5 kg of concentrates to carry calcined magnesite until the end of May. No concentrates were fed in the pre-calving period, with the exception of the in-calf heifers. Groups B and D were fed 7.3 kg of concentrates from calving until the mid May when concentrate feeding ceased. From early July until mid August supplementary feeding at the rate of 3.2 kg a day was introduced to groups B and D as milk yields were declining at over 2½% per week at this period. Concentrates were introduced to both B and D in early September at the rate of 3.2 kg of concentrates per day until drying off in mid-November. This experiment then allows a comparison of more normal management groups, A and C with groups B and D where higher inputs of concentrates are fed to overcome possible feed deficits during the mid summer period and at the end of the grazing season where herbage availability is declining. The results for 1978 are presented in Table 8.

Table 8

Effect of level of concentrate feeding and stocking rate on lactation performance—Moorepark 1978

	Treatment			
	A	B	C	D
Stocking rate (ac/cow)	1.0	1.0	0.8	0.8
Concentrates (kg/cow)	500	1000	500	1000
Milk yield (gal/cow)	771	892	719	822
Yield difference (gal) AvC&BvD	121		103	
Response (kg concentrate/kg of milk)	0.9		1.0	

The feeding of an additional 500 kg of concentrates resulted in increased milk output of over 100 gallons for both stocking rates, resulting in a response of 1 kg of extra milk/kg of concentrates fed for both stocking rates. At present concentrate prices (£130) ton) this would not be economical. However if cheaper feed ingredients were available there maybe some economic justification of higher levels. In Table 9 the responses to the additional meals over the different periods in the lactation are shown. They indicate clearly that the continuation of concentrates from mid April to mid May gave a very poor response in milk yield. Better responses were obtained to mid lactation and late lactation feeding. But again the feeding levels are not economically justified at concentrates costing between £125 and £130 a ton.

Table 9

Effect of concentrate feeding at different periods of the lactation

	Treatment					
	A		B	C		D
Stacking rate (ac/cow)	1.0		1.0	0.8		0.8
Concentrates (kg/cow)	500		1000	500		1000
Milk yield (gal/cow) Calving to 15th April	286		275	290		283
Milk yield (gal/cow) 16th April to 13th May	73		82	67		78
Concentrates (kg/cow)	0		165	0		165
Response (kg conc/kg milk)		3.9			3.2	
Milk yield (gal/cow) 2nd July - 12th August	93		122	82		110
Concentrate (kg/cow)	0		134	0		134
Responses (kg conc/kg milk)		1.0			1.0	
Milk yield (gal/cow) 3rd Sept. - 18th Nov.	111		167	93		131
Concentrates (kg/cow)	0		229	0		229
Response (kg conc/kg milk		0.9			1.3	

This experiment is also in its first year and it is not possible to make definite conclusions on the feeding of the additional concentrates particularly during the mid and late lactation periods. Half of the animals in this experiment were in their first lactation.

Cull cows

Data from a cull cow nutrition experiment at Moorepark were used to demonstrate the effect of level of nutrition and body condition on animal performance. The object was to provide information on liveweight gains attainable by cull cows and to determine the economics of overwintering them. It was possible during the trial to examine the effect of condition and to relate condition changes to liveweight.

Thirty-five non-pregnant cull cows from spring-calving herds were assembled and divided on the basis of body condition into high and low score groups. These groups were fed moderate quality silage and concentrates as follows:

High score—*ad libitum* silage.
High score—*ad libitum* silage + 4 kg concentrates daily.
Low score—*ad libitum* silage.
Low score—*ad libitum* silage + 4 kg concentrates daily.

The trial lasted 92 days (7/11/77 to 9/2/78). The concentrates used contained 16% crude protein; silage intakes were measured. At the end of the trial the animals were slaughtered and six carcasses from each group were divided into muscle, fat and bone components. Performance and carcass disection data are given in Tables 10 and 11, respectively.

Table 10

Performance of cull cows

	High score		Low score	
	Silage	Silage + concentrates	Silage	Silage + concentrates
No of animals	8	10	7	10
Initial fasted wt. (kg)	496	498	453	451
Final fasted wt. (kg)	528	556	488	516
Gain (kg)	32	58	34	65
Gain/day (kg)	0.35	0.63	0.38	0.71
Initial score	3.3	3.0	1.9	1.7
Final score	3.9	4.3	2.8	3.8
Change	+0.6	+1.3	+0.9	+2.1
Silage/cow (tons)	3.1	2.5	3.5	2.8
Concentrates/cow (kg)	—	360	—	360

All groups increased liveweight during the trial. Low score animals had a slightly higher rate of gain and consumed an extra 0.4 tons of silage per animal. There was a good liveweight response to concentrate feeding and rate of gain for these cows was double that of the silage only groups. They consumed less silage, substituting concentrates for silage at the rate of 1 kg concentrate dry matter for 0.4 kg silage dry matter. All groups improved condition and attained good scores within the 92 days.

The low score groups had lower killing-out percentages; they had lighter carcasses and csonsequently a lower total yield of lean meat, fat and bone (Table 11).

Carcasses from high score cows yielded more lean meat but also gave much greater yields of fat. This was especially true for the concentrate fed group.

Table 11

Carcass dissection data from cull cows

	High score		Low score	
	Silage	Silage + concentrates	Silage	Silage + concentrates
No. of animals	6	6	6	6
Carcass wt. (kg)	265	296	232	248
Kill-out %	50.2	53.2	47.6	48.0
Side wt. (kg)	133	148	116	124
Total side lean (kg)	92	102	82	89
Total side fat (kg)	11.5	15.0	7.9	8.8
Total side bone (lb)	28.8	30.4	26.4	26.1
% Lean	69.6	69.3	70.4	71.8
% Fat	8.6	10.2	6.8	7.1
% Bone	21.7	20.6	22.7	21.1

Cash returns are shown in Table 12. All groups showed a profit. High score cows returned the greatest margin over feed costs. Despite improved liveweight gains the meal fed groups left a lower margin. The return from low score cows fed concentrates was particularly disappoint-

Table 12

Feed costs and profit margins in the over wintering of cull cows

	High score		Low score	
	Silage	Silage + concentrates	Silage	Silage + concentrates
Returns/cow (£)				
Initial value*	249	249	222	220
Final value**	314	344	274	297
Difference (a)	65	95	52	77
Feed costs/cow (£)				
Silage @ £7/ton	22	18	25	20
Concentrates @ £120	—	43	—	43
Total feed costs (b)	22	61	25	63
Margin/cow (a-b) £	43	34	27	14

* Calculated from prevailing factory prices at a standard kill-out of 48%

** Factory returns

ing. This shows clearly the impact of meal costs on profit margin. For example, the low score silage group returned almost the same margin as the high score concentrate fed cows even though technical performance and carcass composition were quite different.

This trial provided an opportunity to relate liveweight gain to condition changes in cows in a situation uncomplicated by calf growth. It emerged that the value of a condition score unit in terms of liveweight varied at different levels of condition. For low scores or "thin" cows, a change in condition of one unit was associated with a liveweight increase of about 34 kg; for higher score or "good" condition cows, the corresponding figure was 50 kg.

Modern Milking

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This review of modern milking requires some definition of the term "modern". A survey of milking practices and equipment in Ireland was carried out in 1960 and the results of that survey provided the impetus for subsequent milking research. For the first time, research reports named the makes of equipment. Previously, components which were tested in Research Institutes were identified only by code numbers.

Table 1 shows the percentage of the herds of different sizes which were milked in different types of sheds and the milking rates of the herds. The outstanding feature of the data was the low number of cows milked per man per hour.

Table 1

1960 Survey results on milking practices

	Herd size				Total
	8-13	14-20	21-32	33	
No. machine milked in cowhouse	26	110	109	51	296
No machine milked in parlour	1	9	18	18	46
Percentage machine milked	9%	38%	60%	78%	37%
Cows milked/man/hour					
Hand milking	7.2	6.4	6.4	6.5	
Machine milking	11.8	10.9	10.6	12.7	

Table 2

Percentages of herds with milking machines which were hand milked for part of the year

Hand milking duration (weeks)	Herd sizes (cows)			
	8-13	14-20	21-32	Over 33
1 - 6	—	3.4%	4.7%	4.3%
7 - 12	7.4%	18.5%	18.9%	10.1%
13 - 18	14.8%	6.7%	8.7%	5.8%
19 - 24	22.2%	14.3%	10.2%	5.8%
25 - 30	7.4%	8.4%	6.3%	4.3%

Table 2 shows that a large percentage of herds which had milking machines were hand-milked for part of the year. Ten per cent of the farmers in the survey had reverted to hand-milking from machine milking. Their reasons for this decision are given in Table 3.

Table 3

Reason for discontinuing machine milking and reverting to hand milking

	Percentage of farmers
Drop in yield	31.6%
Mechanical troubles	26.3%
Mastitis	23.7%
Reduced herd size	10.5%
Hand milking faster	7.9%

Present situation

In 1979 it is not unusual to find milkers milking 70 cows per man per hour with a low incidence of mechanical faults, low levels of mastitis and producing milk of high bacterialogical quality. What has happened in the meantime to cause these changes?

After the 1960 survey studies were commenced on seven aspects of milking and milking equipment; the activities were highly inter-related and are separated only for convenience. Similar activities have also been initiated in some other Institutes and milking machine manufacturers have also played a major role in the developments. The inter-related studies sought to improve:

(1) Mechanical efficiency of milking equipment.
(2) The adverse effect of milking machine on infection.
(3) The standard of installation on farms.
(4) Maintenance standards of farms.
(5) Cleaning of equipment on farms.
(6) Milking shed design.
(7) Number of cows milked per man per hour.

Performance tests

To ensure durable and properly functioning milking equipment, milking machines and components were tested under controlled conditions and reports were issued on their performaice. This resulted in a major improvement in the quality of components on the market (Table 4).

The improvement in performance indicated by Table 4 underestimates the actual improvement because the standards were being raised as years progressed. Manufacturers have generally replaced faulty components by satisfactory components from other manufacturers until they had sufficiently improved their own components. By way of comparison, the

Table 4

The percentage of components which were satisfactory at different tests (references are shown as superscripts)

	1966[2]	1968[3]	1974[4,5]	1977[6]
Individual pulsators	20%	0%	36%	56%
Relay pulsators	—	100%	91%	—
Vacuum regulators	20%	17%	36%	40%
Vacuum pumps	84%	100%	100%	100%

percentages of faulty components found on farms in England by MMB surveys are given in Table 5 and these frequency percentages are typical of those in many other countries.

Table 5

Percentages of faulty components in MMB survey of farms in England (References are shown as superscripts)

Faulty component or measurement	1966[7]	1967[8]	1971[9]
Vacuum pump	36%	40%	32%
Vacuum regulator	44%	61%	49%
Pulsation rate	0%	0%	12%
Pulsation ratio	9%	50%	23%
Reserve of plant	24%	40%	30%
Rubberware	11%	80%	—
Plants with at least one fault	—	—	91.7%

Machine milking and mastitis

Several experiments in Moorepark show the relationship between irregular vacuum fluctuations and increased new infections (Table 6).

Table 6

Effect of fluctuating vacuum on new intramammary infections

	No. of new infections	
Experiment	Stable vacuum	Fluctuating vacuum
1	2	13
2	21	44
3	10	21
4	11	24
5	10	23

Source : Nyham (1968)

Larger vacuum pumps and pipes are now being installed to improve vacuum stability and in response to higher reserves vacuum regulators have higher capacities and greater sensitivity.

More recent results have shown a relationship between liner slip and high new infection rates (Table 7).

Table 7

Effect of liner slip on new intramammary infections

Experiment	Quarters affected by slip	Quarters not affected by slip
8	35	11
9	17	3
10	23	7

Source : O'Shea & O'Callaghan (1978)

Manufacturers are now trying to improve the stability of the liners on cows' teats to reduce the risk of infection and to minimize the disruption to milk incurred by slips and fall offs.

Standard of installation

Milking machines will be properly installed if farmers request that machines are installed to the Irish standard IS 187 and get a written agreement from the installer that the machine will be so installed.

Maintenance

Installers generally provide a routine maintenance chart. Farmers should follow these instructions. Technicians have been trained at Moorepark and more recently in the Regional Technical Colleges for testing of milking machines. Every machine should be tested at least once a year by such a trained technician and his recommendations should be followed. There is evidence that faults develop on milking machines on many farms due to bad maintenance (Table 8).

Table 8

Faults in a sample of Irish machines in 1972

Incorrect component or measurement	% of plants faulty
Vacuum pump	9.3
Pulsation rate	14.8
Pulsator	13.8
Liner condition	18.7
Controller sensitivity	38.9

Cleaning of milking machines

Cleaning problems are minimal in properly installed machines. Simple cheap methods of cleaning have been developed and have proven very satisfactory. Ease of cleaning is monitored during performance tests on components.

Milking shed design

A booklet on milking shed design is available from The Agricultural Institute. Milking sheds should have pipelines rather than recorder jars. Herring bone sheds should have two stalls per unit; sheds should not generally have feeders or automatic cluster removers. To record yields milk meters can be used at 3 - 5 week intervals for recording yields. Double-up parlours (1 stall per unit) are only 60% as efficient (cows milked per unit per hour) as two stall per unit plants.

Automatic cluster removers were originally designed to prevent increased mastitis due to over-milking. However, there was no evidence available to suggest that over-milking increased mastitis. The effect of cluster removers on herd milking rates in a New Zealand survey was variable. There was an increase in output of up to 25% in milking rate where milkers had corrected wrong routines (spending a lot of time trying to avoid over-milking). At the other end of the scale there was a depression of up to 8% in output due to using automatic cluster removers.

Throughput of cows

The number of cows milked per man per hour will largely be determined by the number of units handled and this in turn will be determined by the milking shed design and properly functioning milking equipment which needs no alterations during milking. Machine stripping can be omitted with clusters which have low strip yields and this will allow more units to be used.

Ancillary equipment

As the duration of machine milking is reduced, the ancillary activities such as yard-washing, cleaning of the milking machine, etc., are becoming a greater percentage of total time spent in the milking shed. Consequently, increased attention is being given at Moorepark to ancillary equipment such as different types of in-parlour feeding automatic cluster removers, automatic recorder jar emptying, yard-washing and stand-by generators.

Electronics

In the past few years there has been a continuing proliferation of electronic equipment for performing various functions in milking machines. Whilst some of the future improvements in milking equipment will be by means of electronic devices, not many advantages have yet been proved. Manufacturers should be required to conduct adequate testing of new equipment or ideas before they are sold to the consumer. Farmers should be aware of those features which are fashions and those which are necessities.

Summary

1. Performance testing ensures that milking equipment available to Irish farmers is as good as is available anywhere in the world.
2. Machines will be properly installed if specified to IS 187.
3. Maintenance on farms and a yearly test by a technician is essential.
4. Milking shed design should be simple and proliferation of equipment which serves no useful purpose should be avoided.
5. Up to 70 cows per man per hour can be milked in simple milking sheds with good simple milking equipment.

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Milk Supply and Utilisation

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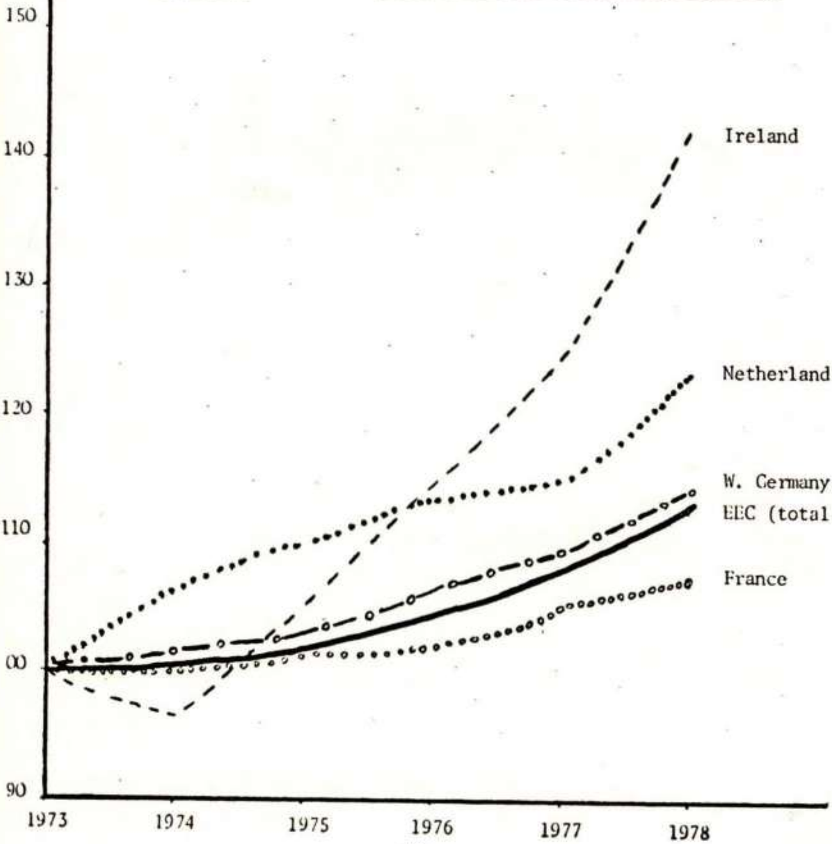
This paper examines a few possible constraints and questions that arise from continued growth in milk output in Ireland. As the economic conditions under which further growth in output might take place will be determined mainly by decisions in Brussels, a few comments on the E.E.C. Commissions proposals are appropriate.

E.E.C. Commission Proposals

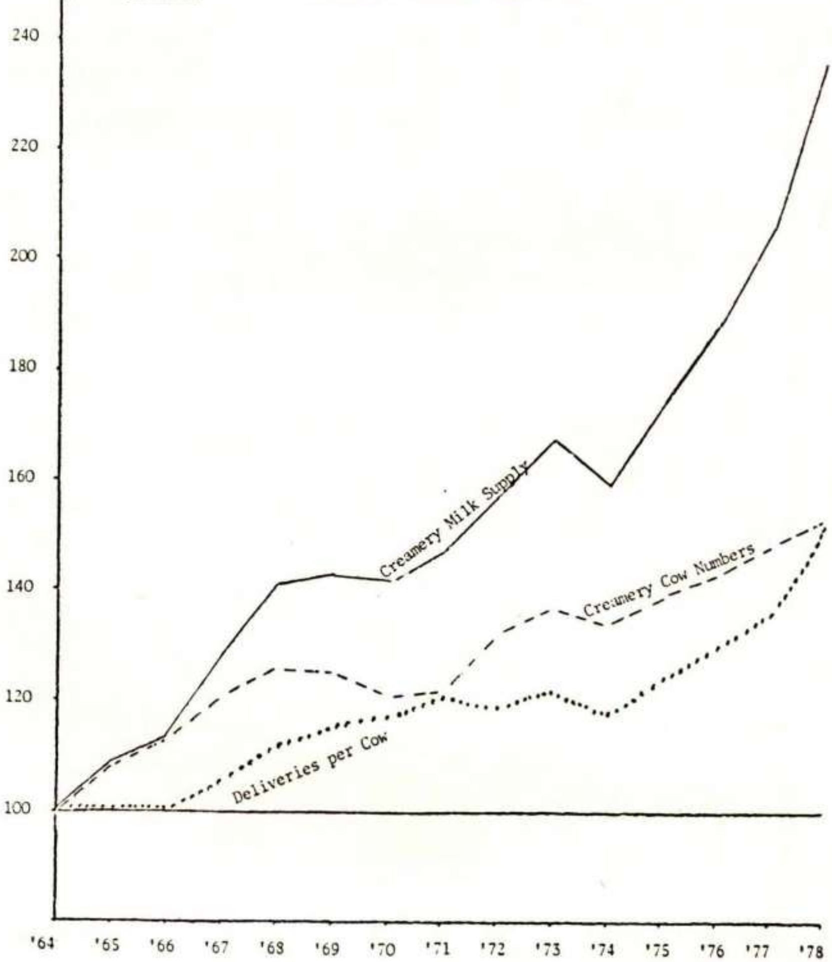
Since E.E.C. membership any proposals related to changes in marketing conditions should be approached firstly by reference to one central

FIGURE 1 MILK DELIVERED TO DAIRIES (1973-1978)



principle, namely, that any measures applied should be *common* measures applying throughout the Community so that Irish producers are maintained in a similar competitive position with producers elsewhere in the Community. This is the central principle of the Common Agricultural Policy. The underlying theory is that under a system of common measures production will tend to locate itself in the regions best suited to it. The favourable consequences of this principle for Irish milk production over the past six years are clear from Fig. 1. The relative growth rates in milk supply of the different countries strongly suggest that even

FIGURE 2 SOURCES OF CREAMERY MILK SUPPLY



if Community production is no longer to expand into the future, Irish production can still expand considerably, so long as the principle of *common* measures applying throughout the Community is preserved. But the introduction of special measures to be applied on a regional or a supplier basis, resulting in regions or suppliers with a higher output growth paying higher penalties, would be contrary to the Common Agricultural Policy, and would mean that a common policy for milk would no longer exist.

Future milk output in Ireland

If milk output continues to increase, will further supplies come from increased yields or greater cow numbers? Study of past performance (Fig. 2) shows that:

(i) In the decade before E.E.C. membership 1963-1973, creamery milk output increased by nearly 67%; two thirds of this increase was due to increased cow numbers and one third was due to increased yield.

(ii) Since E.E.C. membership in 1973 creamery output increased by 42%. However, almost two thirds of this increase was due to increased yield, with only one third due to greater cow numbers (Table 1). Yields at present are estimated at 650 gals. per cow on average and have increased by about 140 gals. on average since E.E.C. membership in 1973.

Table 1

Milk output, cow numbers and yield changes

	Creamery milk output	Proportion due to: Creamery cow numbers	Deliveries per cow
1964 - 1973	+67%	63%	37%
1973 - 1978	+42%	33%	67%

Milk yield

Let us consider the factors which contributed to increased yields. Meal feeding levels increased from 4½ cwts. per cow in 1973/74 to about 9½ cwts. per cow in 1978 and milk yields increased by 140 gals. per cow in this period (Table 2). How much have meals contributed to increased yields? It depends on making an assumption on the response from increased meal feeding. Assuming 7 lbs. meals/gal., it is estimated that about 78 gals. was produced from extra meals. On this basis about half of the 140 gal. increase was therefore due to other factors, i.e., improved husbandry and breeding, better grassland management, more selective culling, earlier calving, etc. The increase in meal feeding has been associated with a more favourable milk to meals price ratio (Table 2).

Table 2

Meal feeding in the creamery herd

	Concentrates fed/cow		lbs meals purchased by 1 gal	kgs meals purchased by 1 litre
	cwts.[1]	kgs		
1978[e]	9.5	482	9.0	0.90
1977	6.9	350	8.4	0.84
1976	5.8	295	8.3	0.83
1975	5.5	279	8.0	0.80
1974	4.7	239	6.2	0.62
1973	4.6	234	6.9	0.68
1968	3.8	113	6.3	0.63

[e] Preliminary estimate

[1] Source : B. Kearney, Production Economics Unit, The Agricultural Institute

In the future it is unlikely that the milk/meal price ratio will become more favourable. Hence, further yield increases will depend more on the other aspects of dairy husbandry as listed above.

Cow numbers

In discussing growth in cow numbers it is more relevant to consider total cows rather than the creamery herd only. One of the surprising aspects of E.E.C. membership to date is that total cow numbers have remained static. While creamery cow numbers have grown, this growth has merely replaced the fall in beef cow numbers, and from the latest figures close to zero growth will be true for 1979 also. In contrast, there was a steady growth of about 3% per annum in total cow numbers in the decade prior to E.E.C. membership (Fig. 3).

In explaining the lack of growth in total cow numbers since 1973, the cattle crisis in 1973/74 is of foremost consideration. However, there are other factors which merit discussion:

1. the culling rate, as a percentage of the total cow herd;
2. the replacement rate, as a percentage of the total cow herd.

By definition if the inflow of heifers or the replacement rate is greater than the culling rate, the herd increases in sizes.

In general, up to 1973 the culling rate averaged 17% and the replace-rate was 20%. Hence, growth in the total cow herd was 3% per annum. The culling rate fluctuates much more widely as can be seen from Fig. 4, between the extremes of 12 - 25%, compared with a very steady replacement rate. The periods of rapid growth, 1963 - 1965 and 1970 - 1973 were associated mainly with a large drop in the culling rate.

FIGURE 3

GROWTH IN TOTAL COW HERD

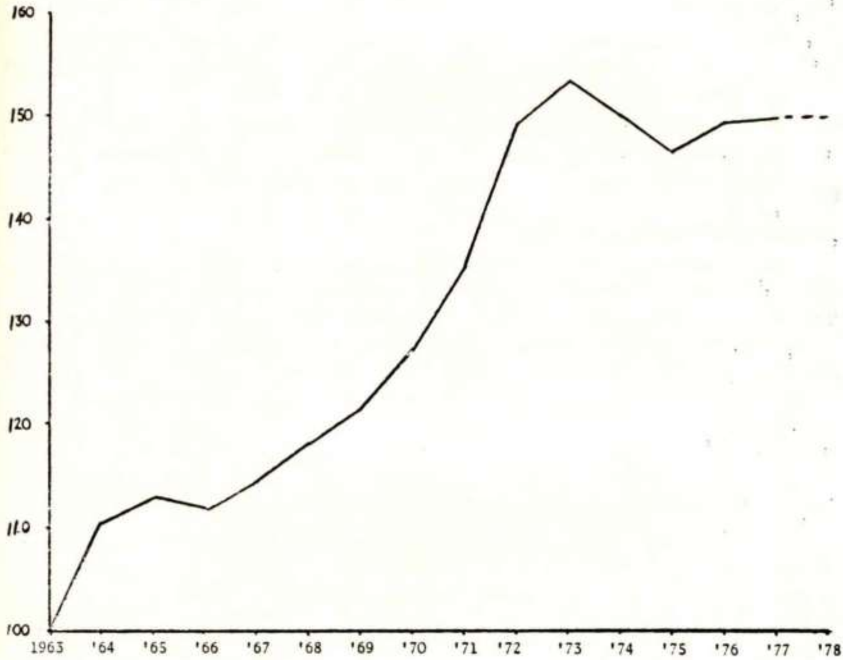
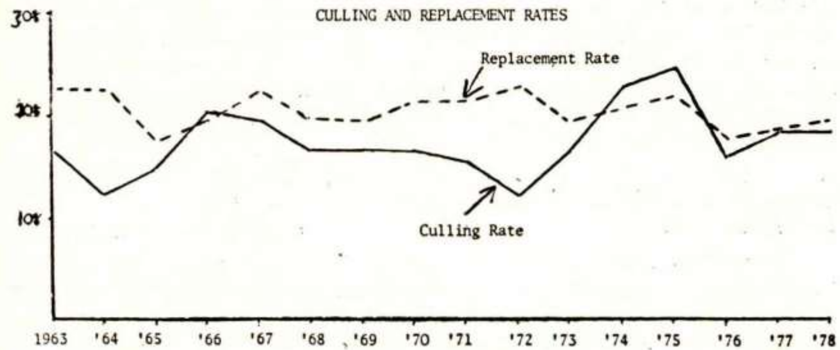


FIGURE 4

CULLING AND REPLACEMENT RATES



Since 1973 the culling rate has moved on average to about 20%, the replacement rate has remained at 20% with the result that there has been no growth at all in the total herd. The points arising with regard to future herd growth are:

1. Has the culling rate now moved permanently to a higher level of 20% and will it possibly move even higher over the next few years due to the disease eradication programme?
2. If (1) is accepted then there can be no herd growth until the replacement rate moves towards 25% of the herd, i.e. proportionately more heifers would need to be directed for breeding, and fewer for beef.

Heifers for breeding or beef

The breakdown of the utilisation of heifers as between breeding and beef in recent years provides some interesting insights. From approximately 2 million cows over 800,000 maiden heifers are utilised each year either for breeding or for beef production. A breakdown of heifer utilisation for the past five years shows very consistently that about 45% of maiden heifers were utilised for breeding and about 55% for beef (Table 3). The 45% for breeding corresponds to the 20% replacement rate in the cow herd outlined earlier. Now if the replacement rate is to move towards 25% of the cow herd to provide cow herd growth in the future, then the breakdown in the utilisation of maiden heifers must be reversed.

Table 3

Outflow of maiden heifers

Year	1974	1975	1976	1977	1978[e]
For breeding as % of total	45.8	43.2	45.8	45.9	46.4
For beef as % of total	54.2	56.8	54.2	54.1	53.6

[e] Perliminary estimate

In other words, 55 - 60% of maiden heifers must be allocated to breeding, leaving 40 - 45% for beef production. This change in the utilisation of heifers would firstly have important implications for breeding policy. Secondly, from an economic view point, schemes for retaining heifers for breeding instead of selling heifers as beef animals may be required, particularly in the case of the beef cow herd.

Increased milk output—implications for processing sector

If creamery milk supplies continue to increase, what are the implications for the processing sector? The need for extra capacity depends firstly on the seasonality of milk supplies. This subject has been discussed in detail at previous conferences (1). Hence, only a summary of the conclusions is given here.

Table 4

Butter manufacture by month 1977

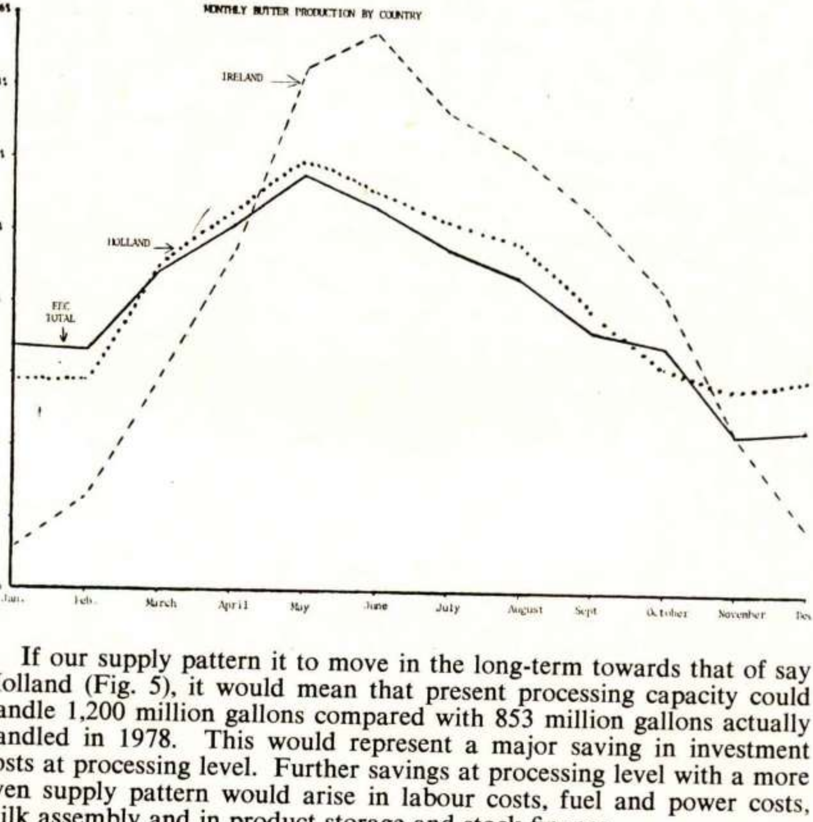
	Germany	France	Italy	Netherlands	Belgium	UK	Denmark	Ireland	EEC (Total)
January	8.2	6.9	6.8	5.8	5.0	6.2	7.4	1.2	6.8
February	7.6	6.9	7.0	5.8	6.3	5.8	6.9	2.6	6.6
March	9.7	9.1	9.0	9.0	8.4	7.8	9.2	5.8	9.0
April	10.1	10.1	10.1	10.5	8.8	10.1	10.5	9.8	10.1
May	10.7	11.6	9.9	12.0	12.5	12.3	11.6	14.5	11.5
June	9.5	10.8	9.3	11.1	11.7	11.5	10.0	15.5	10.7
July	8.9	9.5	9.5	10.3	10.8	8.9	8.6	13.3	9.6
August	8.3	8.5	9.0	9.7	10.2	7.6	7.8	12.2	8.8
September	6.6	7.1	8.0	7.8	8.2	6.5	6.6	10.5	7.2
October	6.6	6.7	8.0	6.3	7.3	7.8	7.2	8.4	6.9
November	6.4	6.4	6.9	5.7	6.2	7.4	6.9	4.4	6.4
December	7.4	6.4	6.5	6.0	4.9	8.2	7.2	1.9	6.5
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Capacity[1] utilisation %	78.1	72.2	82.8	69.3	66.9	67.8	71.8	53.7	72.3

Source : Eurostat

[1]Capacity utilisation $= \frac{100}{\text{peak month} \times 12}\ \%$

Irish manufacturing milk supplies are highly seasonal, unlike the remainder of the E.E.C. (Fig. 5). In butter manufacture, if production in the peak month is taken to be at 100% factory capacity, then overall capacity utilisation in the year in Ireland is slightly over 50%. In contrast to this, all other E.E.C. countries have a corresponding capacity utilisation of the order of 70 - 80% (Table 4).

FIGURE 5



If our supply pattern it to move in the long-term towards that of say Holland (Fig. 5), it would mean that present processing capacity could handle 1,200 million gallons compared with 853 million gallons actually handled in 1978. This would represent a major saving in investment costs at processing level. Further savings at processing level with a more even supply pattern would arise in labour costs, fuel and power costs, milk assembly and in product storage and stock finance.

On the other hand, a Dutch type milk supply pattern would involve a substantial amount of autumn calving and much higher milk production costs. Estimates of the increased milk production costs are based here on a three year experiment carried out by An Foras Taluntais at Ballyraggett a few years ago (2) in which specialised autumn calving and spring calving herds were maintained, i.e. present day costs are

[2] P. Gleeson : "Pre and Post Calving Feeding of Dairy Cattle", Journal of Irish Grassland and Animal Production Assoc., 1974.

applied to the physical performance levels in the experiment. From this work it is concluded that autumn calvers would require at present about 10p/gal. extra over the whole of the lactation to compensate for their increased costs, mainly due to the increased meal feeding. A Dutch type milk supply pattern would involve about 45% autumn calving and 55% spring calving, as derived from the shape of lactation curves. Hence the 45% autumn calving at a production cost increase of about 10p/gal. is equivalent to a 4.5p/gal. milk production cost increase when spread over the total milk supply.

The total savings at processing level from a Dutch type milk supply pattern have been estimated at about 2½p/gal., which is very considerable in processing cost terms, but is only about half of the increased milk production cost. Hence, it was concluded that movement to autumn calving for a proportion of the creamery herd, to give a milk supply pattern similar to Holland, would not be advantageous in overall terms for the Irish creamery industry.

This is not to suggest that our calving dates should remain static. The mean calving date for the creamery herd at present is centred on March, but has been moving forward steadily over the past couple of years. Examination of lactation curves for January and April calvers, based on a sample of 1,200 cows in Moorepark herds, shows that lactation for a January calver is 10 months in duration and is evenly spread through the year, whereas the lactation for an April calver is about 8 months in duration and reaches a peak in May/June, the period of the creameries overall peak supply (Fig. 6). Hence movement towards earlier calving should result in some improvement in capacity utilisation at the processing level.

All the above discussion on seasonality has been related to storable products. Some level of autumn calving would be desirable in the development of short life products, which firstly require more milk in winter than is currently available and secondly, give sufficient returns to economically support a level of autumn calving on farms.

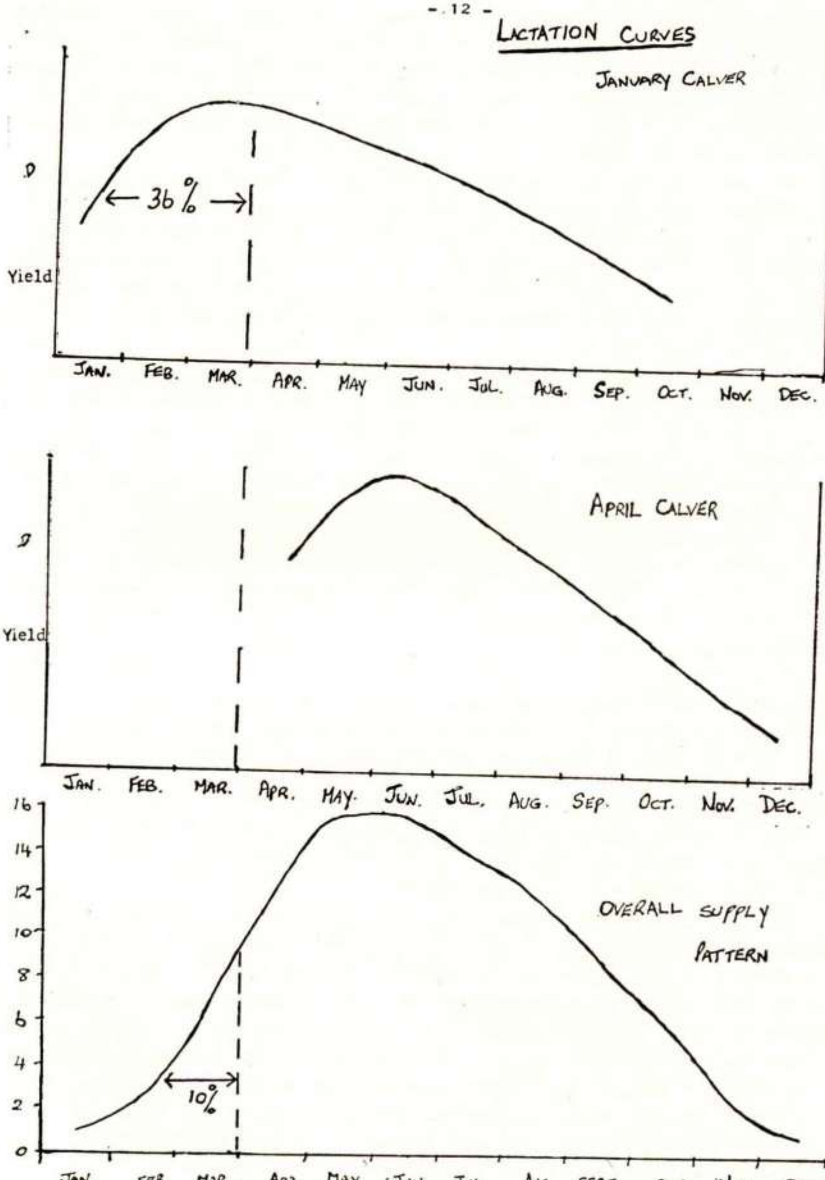
Efficiency

The prospect of limited price increases in the immediate future places more emphasis on improvements in efficiency at all levels of the industry as a means of increasing returns.

One important area where efficiency can still be improved is milk assembly. It is many years since bulk collection was first discussed, and now over 50% of milk in the country is collected in bulk. However, the branch creamery system has remained in many areas and is operating side by side with bulk collection. The consequences are:

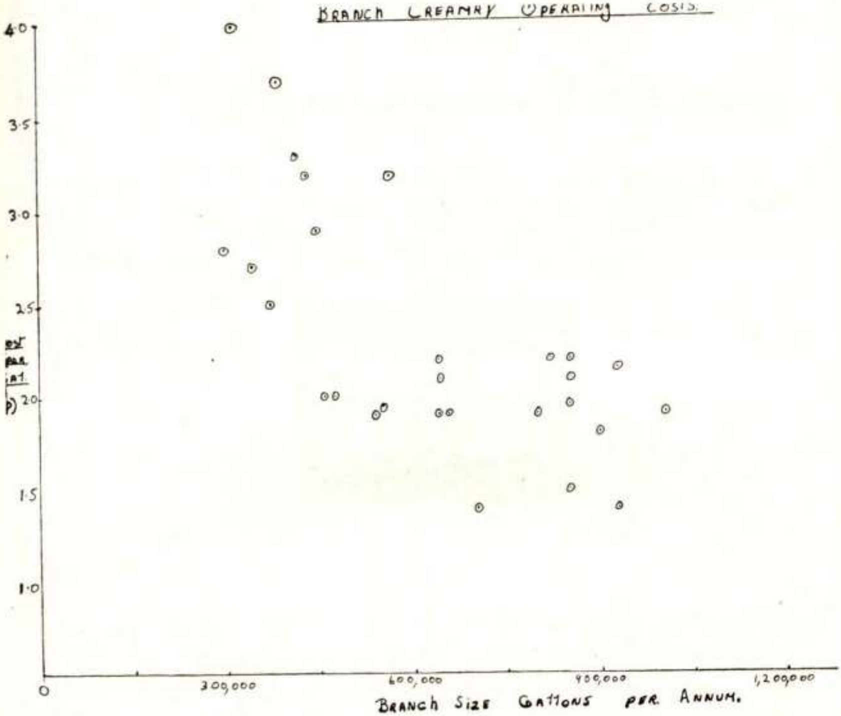
1. For bulk collection, while many suppliers still deliver to branch creameries, bulk tankers must travel long distances to collect a full tanker load thus increasing bulk collection costs.
2. The remaining branch creamery system is even more costly than the original, as the throughput at a branch falls when some of the big suppliers change to bulk collection, thus raising branch creamery operating costs.

FIGURE 6


- 12 -
LACTATION CURVES
JANUARY CALVER
Yield
← 36% →
JAN. FEB. MAR. APR. MAY JUN. JUL. AUG. SEP. OCT. NOV. DEC.
APRIL CALVER
Yield
JAN. FEB. MAR. APR. MAY. JUN. JUL. AUG. SEP. OCT. NOV. DEC.
16
14
12
10
8
6
4
2
0
10%
OVERALL SUPPLY
PATTERN
JAN. FEB. MAR. APR. MAY JUN. JUL AUG. SEPT. OCT. NOV. DEC.

Studies of branch creamery operating costs in a number of co-ops in recent years show that for branches with greater than 500,000 gals. per annum, a 2p/gal. cost would be the norm, whereas for branches receiving less than 500,000 gals. per annum, a 3p/gal. cost would be typical (Fig. 7).

FIGURE 7



The present position in many cases is that when some large suppliers leave branches and transfer to bulk, the branches are changed from the greater than 500,000 gals. category to the less than 500,000 gals. category. In other words, the branch creamery system, which is already a very costly system of assembly, is becoming even more costly. Both systems, branch and bulk, are at their highest cost when both are operating side by side. It is surely time that the final stage in implementing bulk collection was reached.

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A Comparison of the Economics of Milk Production in Ireland and Great Britain

H. C. HUGHES

Extract from the British Milk Marketing Board, LCP Information Unit Report.

This extract from the Report compares the results, both physical and financial, for the two main samples of farms in Ireland and in England and Wales. It should be remembered that the results are simple averages and as such conceal a wide range of individual performance.

Physical results

The physical results for the two samples of farm are shown in Table 1).

Table 1
Physical results for the two samples

	Ireland	LCP
Number of farms	112	73
Farm size (hectares)	48	74
Herd size	51	89
Other stock (livestock units)	26	34
Milk yield per cow (litres)	3,290	5,000
Proportion of milk produced in summer (per cent)	70	55
Concentrate use per cow (kg)	425	1,800
Concentrate use per litre (kg)	0.13	0.36
Concentrate use to young stock (kg per LSU)	335	690
Stocking rate (LSU per ha)	1.75	1.90
Nitrogen use (kg per ha)	170	250

The farm size of the LCP sample was 50 per cent greater than that of the Irish sample. Land appeared to be utilized more intensively, as measured by a greater rate of nitrogen application and a higher stocking rate.

The management of the herds as reflected by milk yield and concentrate input varied widely, the LCP farms obtaining an extra 1,710 litres of milk per cow whilst consuming an additional 1,375 kg of concentrate. This pattern reflected a complete dominance of spring calved animals in the Irish herds, whilst the LCP sample comprised animals calving at all times of the year. Further, Ireland has historically suffered low milk prices, encouraging a low cost system, while in the U.K. far more emphasis has been placed on yield per cow.

Financial results

At the time of this study there was no difference in the value of Irish and U.K. currency. However market prices in the two countries differ; an outline of the cost of the major commodities has been abstracted from the two samples (Table 2).

Table 2

Comparison of prices of major commodities (1977)

		Ireland	LCP
Freshly calved heifer	(£)	450	380
Cull cow	(£)	230	220
Calf	(£)	50	35
Milk price (pence per litre)		10.4	9.7
Concentrate price (£ per tonne)		119	104
Nitrogen price (£ per tonne—34 per cent N)		85	62

The most commonly used measure of dairy cow efficiency is margin over concentrate, made by combining the physical results with the price levels indicated above. This margin for the Irish farms was £292 per cow compared with £295 in the case of the LCP sample. These figures were surprisingly similar when one considers the radically different approach to concentrate feeding coupled with the difference in milk output.

Incorporation of the other costs and returns attributable to the dairy enterprise enabled construction of the gross margin shown in Table 3.

Table 3

Gross margin per cow

	Ireland £ per cow	LCP £ per cow
Gross output (a)	364	518
less Concentrate cost	50	187
Other feed costs	0	16
Forage costs	40	40
Miscellaneous variable costs	18	21
Gross margin	256	254
Herd gross margin (£)	13,030	22,618

Note : (a) calculation shown in Appendix 1

The greater return obtained by the Irish for their calves was balanced by a higher cost of replacement heifers, and their reluctance to buy in roughage feeds saved them £16 compared with their LCP counterparts. The net result was an almost identical gross margin per cow, but with the LCP herds being 75 per cent larger their total gross margin was almost £23,000 compared with £13,000 for the Irish sample.

The whole farm gross margin was obviously influenced by the margins made by other enterprises; the Irish figures in Table 4 being somewhat higher than the LCP figure mainly because of the high transfer value of heifers and the small amount of concentrate fed to them. This high transfer value did at the same time reduce the dairy herd margin. Coupling the gross margins with fixed costs enabled a trading account to be calculated as shown in Table 4.

Table 4

Trading account

	Ireland £	LCP £
Dairy herd gross margin	13,031	22,618
Other gross margins (a)	5,861	3,530
Total farm gross margin	18,891	26,148
Labour	520	4,426
Power and machinery	1,069	4,155
Sundries	1,494	2,105
Property charges	1,334	2,307
Interest	724	2,662
Total fixed costs	5,141	15,655
Depreciation charges	1,240	2,496
Profit	12,510	7,997
Profit per hectare	261	108

Note : (a) calculation shown in Appendix 2

The trading account shows that the Irish farms had substantially higher profit than the LCP sample. This was despite a smaller herd size and a slightly less favourable milk price to concentrate cost ratio. Thus, the Irish converted a shortfall of £7,500 in gross margin to an advantage of over £4,000 in terms of profit. This disparity was highlighted by an examination of the profit achieved per hectare. A comparison of each of the fixed cost items shows that the Irish are geared to a low input approach, as was seen earlier in the case of concentrate. This approach has been fostered over the years when a relatively low milk price was the order of the day.

The period between 1972 and 1978 has brought a fourfold increase in milk price, due to entry to the E.E.C., general inflation, and government action over the green pound. The first two points apply equally to the UK but there remains much greater scope for price increase by devaluation. Whilst in the U.K., inflation has put great pressure on to the already high level of fixed costs, in Ireland, where the costs are historically low, the effect has been far less. Consequently much of the increased milk revenue has immediately been translated into profit.

The cause of the large fixed costs in U.K. dairying may well be that the LCP herds, in gearing themselves up to higher yields, have at the same time adopted systems incurring higher fixed costs, resulting in decreased rather than increased profits.

The low level of fixed costs recorded on the Irish farms is surprising. Observation of the equipment on the farms did however explain the position. Very little fixed equipment was present, indicated by the lower power, machinery and depreciation charges. Typically the farmer owned a second hand tractor plus a fertiliser distributor and very little else. Major tasks such as silage making were often undertaken by contractor. Whilst most dairy cows were housed, the buildings used were simple and intended for only a relatively short life. Further, young stock tended to be outwintered far more than was the case in this country. With almost all land in Ireland being owner-occupied there was no rent to pay and with the majority of land being in the family for generations there was little mortgage commitment. Further, the low-key nature of the businesses resulted in very low bank borrowing.

The net result was that the fixed costs were one third of the level operating in the LCP herds, leading to a profit of around £12,500 compared with the £8,000 obtained by the LCP sample. However, as was mentioned above, the Irish farms incurred no rent and were less heavily committed financially than the LCP sample. Although this is obviously important when assessing the returns accruing to the farmer himself, it is an unsatisfactory measure of business efficiency. A more suitable estimate can be made in terms of management and investment income as shown in Table 5.

The difference in profit was reduced to some extent by the removal of the high interest charges prevailing on LCP farms, and imposition of rental charge on the wholly owner-occupied Irish farms. Despite this, the Irish sample obtained a management and investment income 30 per cent higher than that prevailing on the LCP farms. This was achieved on a smaller farm which was operating a far simpler system of dairy cow management.

Whilst management and investment income is commonly used as a measure of business efficiency, farmers are more often concerned with the cash position of the business, particularly the availability of cash to meet required capital and private expenditure. A projection of the trading

Table 5

Management and investment income

	Ireland £	LCP £
Profit	12,510	7,997
plus Interest charges	724	2,662
less Value of unpaid labour	2,860	3,432
Rental value of owner-occupied land	3,360	1,860
Management and investment income	7,014	5,367
Management and investment income per hectare	146	73

Note : details of the calculation above are shown in Appendix 3

account supplied by An Foras Taluntais has therefore been made to construct a cash account and balance sheet. This was done by making personal visits to a small sample of 10 farms. The comparative LCP figures are however results from the original sample of 73.

Table 6

Cash flow

	Ireland £	LCP £
Profit (excluding depreciation charges)	13,750	10,493
Adjustment for valuation changes/capital introductions (a)	4,057	3,041
Commitments : Private spending	2,750	4,023
: Tax	200	750
Cash available for reinvestment	6,743	2,679
Capital expenditupre (net)	3,572	5,761
Cash surplus	3,171	−3,082

Note : (a) calculation shown in Appendix 4

It can immediately be seen from Table 6 that the difference in profit was accentuated in cash flow terms. The Irish farms made a surplus of over £3,000 whilst in contrast their LCP counterparts made a deficit of £3,000.

This was partly due to the lower profit made by the LCP sample, aggravated by a greater proportion of this profit being increase in valuation, and also to the higher commitments of the LCP farms in terms of capital and private expenditure. Net capital investment was markedly higher than that made by the Irish sample. This would appear to be due to three reasons: (1) the dairying system adopted is far more intensive, thus requiring greater capital investment to maintain itself; (2) the relatively low profit levels perhaps in certain cases stimulate investment to increase the size of the business; (3) increased investment is a means of reducing the tax burden.

In Ireland, however, an extensive dairying system is practiced and, farmers paid no tax before 1974. Further, the predominant reaction to low profits in the past has been to tighten the belt rather than intensify.

However whilst the LCP capital expenditure was higher in absolute terms, the figures were almost identical on a per hectare basis. This might be taken as evidence that the Irish, as a result of current profitability, are now embarking on a capital improvement programme. Such expenditure will be further encouraged when the effects of taxation are realised.

The attitude to capital investment was also reflected in the approach to private spending. Despite the large profit made in the current year, private spending of £2,750 was small compared with the £4,023 spent by LCP farmers.

Whilst cash is important, it may often be satisfactory from a business point of view to increase an overdraft in particular, or liabilities in general, so long as asset values are increasing at a rate to compensate both for this and inflation. With the rapid escalation in land values over the past year, both samples were able to achieve this comfortably, but a better assessment of the business position of the two samples can be made by comparing the balance sheets at a single point in time. (Table 7).

The most obvious difference was in land values, mainly due to the Irish being entirely owner occupiers whilst in the LCP sample half of the land farmed was rented. Further, land values in Ireland were higher at around £4,500 per hectare compared with an average of £3,000 in England and Wales. Otherwise the most salient point was the difference in liabilities, the LCP sample having far higher levels of commitment, synonymous with the more intensive nature of the business referred to earlier. One aspect of Irish policy with regard to borrowing seemed to be a desire to take as much money as possible in the form of a long-term loan. This contrasts with the LCP sample where a much higher proporportion of the borrowing was taken as bank overdraft.

Combining the farm profitability, as expressed in terms of management and investment income, with the tenants capital taken from the balance sheet showed a return of 23 per cent for the Irish farms, as against 11 per cent for the LCP sample. These figures confirm the outline drawn above of a currently more prosperous Irish dairy industry.

Table 7

Balance sheet — autumn 1977

	Ireland £	LCP £
Assets		
Land	86,400	44,580
Buildings	2,404	3,869
Breeding herd	11,838	19,247
Other fixed assets	8,336	8,805
Current assets	10,972	22,299
Total assets	119,950	98,800
Liabilities		
Creditors (a)	0	5,017
Bank overdraft	450	8,551
Mortgages and long term credit	5,440	12,938
Total liabilities	5,890	26,506
Net worth	114,060	72,294

(a) See Appendix 4

Thus we have a picture of Irish dairying being on a solid financial base that has existed for some time. However, high profits have now been added to this foundation and this is beginning to reflect in increased capital investment and private drawings. If current levels of profit continue, it seems inevitable that this change will accelerate.

Appendix 1

Calculation of gross output per cow

	Ireland £	LCP £
Milk income	341	482
Calf income	47	32
Cull cow income	33	47
Valuation increase	49	32
less Replacement cost	106	75
Gross output	364	518

Appendix 2
Calculation of other gross margins

	Ireland £	LCP £
Outputs		
Cattle	4,370	1,647
Other livestock	153	116
Crops	1,514	550
Transfers to dairy herd	1,850	3,591
Valuation increase	804	3,113
Miscellaneous	0	566
Expenses		
Concentrate	881	3,250
Forage	250	1,636
Miscellaneous	1,699	1,167
Gross margin	5,861	3,530

Note : the apparent discrepancies in forage and miscellaneous costs are due to differences in accounting procedure

Appendix 3
Management and investment income
Calculation of the value of unpaid labour

	Ireland	LCP
Standard man-day requirements		
Dairy cows @ 5 per cow	255	445
Young stock @ 4 per livestock unit	104	136
Arable crops @ 2.5 per ha	10	13
Forage crops @ 1.8 per ha	79	124
Total	448	718
European SMD per annum	275	275
Number of European men required	1.6	2.6
Number of employees	0.3	1.3
Work done by farmer and family	1.3	1.3
Number of hours worked by farmer	2,860	2,860
Labour value per hour (£)	1.00	1.20
Value of unpaid labour (£)	2,860	3,432

Note : that in both samples the same number of standard man days per cow were allocated. It could be argued that as the LCP herd was larger, economies of scale should have been operating. Conversely an argument could be made that the Irish system was far simpler, requiring a lower labour input.

Calculation of the rental value of owner-occupied land

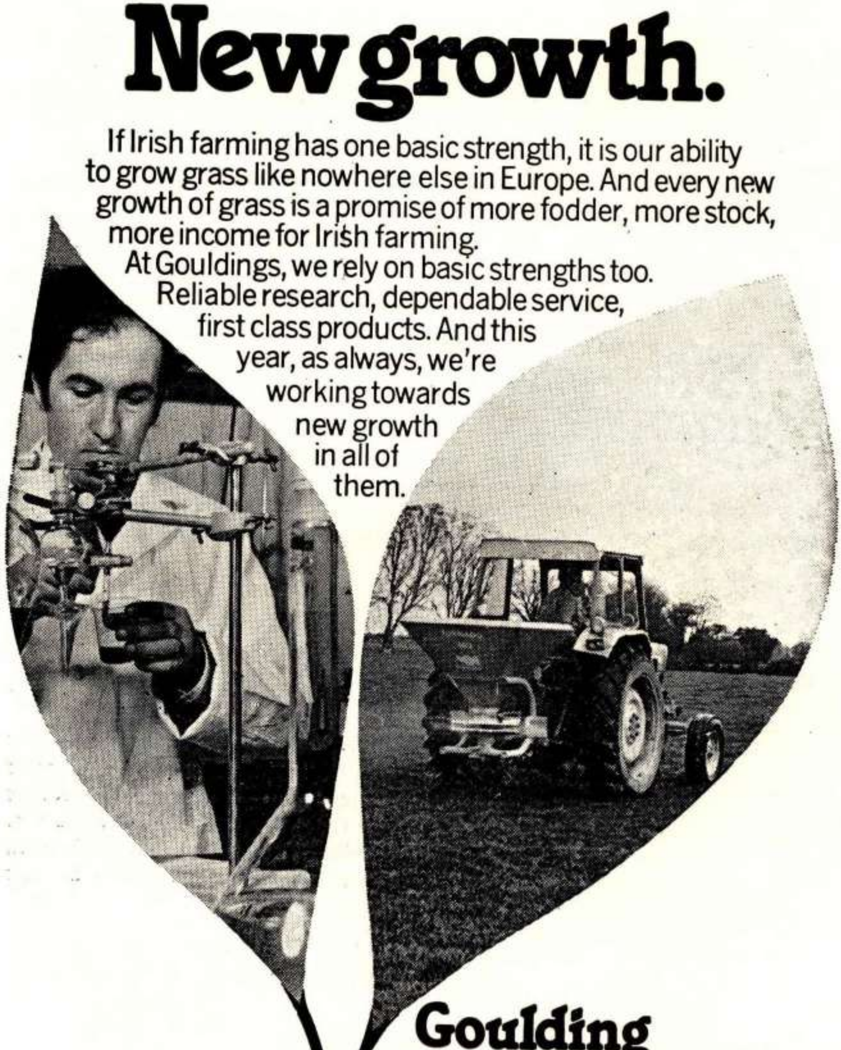
	Ireland	LCP
Estimated land value per ha (£)	4,500	3,000
Estimated rental value per ha (£)	70	50
Area of farm owned (ha)	48	37.2
Rental value of owner-occupied land (£)	3,360	1,860

Appendix 4

Calculation of adjustment made to profit

	Ireland £	LCP £
Cash committed		
Valuation increase	2,807	4,684
Increase in debtors	—	969
Capital repayments	1,250	1,246
Cash made available		
Increase in creditors	—	141
Capital introduced	—	3,328
Private income	—	389
Net cash committed	4,057	3,041

Note that in the Irish sample there is no figure for increase in either creditors or debtors. This is because all costs were taken as current; a procedure which results in little error with all financial year ends being December and almost no businsss activity occurring in that month due to the predominance of spring calved herds. This procedure is, of course, only acceptable if the farms in question are not building up long term debts with merchant companies.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The Scope for Irish Dairying in an E.E.C. Context

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The future of dairying in Ireland is inevitably and closely linked to policies established and pursued at the European level. Europe now has a hand in virtually every aspect of dairying. Yet perhaps the strength of those policies, and sometimes their weakness, is the great bulk of economic activity which takes place within the industry with no direct interference from public bodies. The aspects of strength are primarily associated with allowing the economic forces to take their normal and natural courses. The weakness is related to the fact that so much public funds are now involved directly and indirectly in supporting the industry that public bodies at the European level have a definite obligation in directing the future course of the industry. That obligation, in particular, concerns the growth rates and future size of the industry. Recent policy initiatives by the Commission are directed primarily towards containing the overall size of the industry within reasonable limits and associate that industry size with market requirements.

Market analysis

The market situation in the dairy sector has been analysed in considerable depth in recent years and especially in COM (78) 430 final of the 25th September. The salient points in its conclusions are that production continues to increase and demand is at best static.

On the production side, increases in milk output are almost completely associated with increases in yield/cow. Cow numbers have been remarkably stable over the last decade at about 25 million. Yield per cow which in the late sixties would appear to have been increasing at about 1.7% per year, increased by 2.5% in recent years and in 1978 yield increased by 4%. It is quite clear that yield is increasing at an increasing pace and no place has that been more true than in Ireland. These yield increases are no doubt resulting from improved breeding but in particular they are the result of better herd management and improved feeding, especially using higher levels of concentrate. Even if the ratio of milk price/feed price doesn't improve and perhaps deteriorates in the future, yields will continue to increase as more and more producers get to appreciate and understand the economic and technical relationships involved.

On the demand side, the relationships are much more complex and segmented. Basic consumer habits differ widely throughout the Community. The French consume high levels of butter and cheese; the British and Irish consume a lot of butter and drink milk; the Italians drink wine, and their consumption of cheese is rather low. Strong pressures exist, both naturally and through changing life styles and through market forces, towards reducing butter consumption. Cream and cheese consumption continues to increase. Overall, the Community has been remarkably successful in maintaining consumption levels, in milk equivalent terms, in spite of the market forces, not improved by the general sluggish economies throughout Europe and indeed throughout the world.

The end result, in market terms, is one of ever increased production and milk deliveries to dairies and just about static demand. The extent of the milk surplus in the Community was estimated at 10% in 1976. It has continued to increase since. The extent of surplus perhaps can be more strikingly expressed in terms of product. Of the milk delivered to dairies in the Community, some 40% is converted into butter and skimmed milk powder. On the solids-non-fat side, of the 2 million tons of skimmed milk powder produced, some 90% is sold with levels of support varying between 45 and 90% of the intervention price. When skimmed powder is purchased into intervention at say 95 u.a./100 kg, it is stored for say 2 years, costing a further 24 u.a./100 kg and is then sold for incorporation into pig and poultry rations at about 15 u.a./100 kg. It is surely clear to most people that this is not an economic proposition in the long term. Increasing milk output is sometimes rationalised for Europe by the possibilities which exist for further sales on the world market.

The Community has already a very large share of the world market in dairy products. The total world market is very small compared with world production. In the developed regions of the world, markets are more than adequately supplied with domestic production and hence tend to be protected. In the less developed parts of the world, the required infrastructure does not exist, for handling food aid from the Community. A considerable backlog of earlier years' commitments still remains to be shipped.

In spite of that gloomy picture of the market situation, intervention stocks of skimmed milk powder have been reduced significantly in recent years. While production of powder increased by close to 200.000 tons in 1978, public stocks were reduced by close to 300.000 tons. This was the direct result of the scope and efficiency of the huge arsenal of measures which the Commission now has at its disposal in this sector. However, such an effort is at a large financial cost hence we continue to strive for more effective use of the funds available. From a Community point of view intervention tends to be very expensive and it is much less costly if the skimmed milk can be used directly for say pig feed, thus avoiding the costs involved in drying, financing and storage.

Against this background, it is important to understand the dilemma facing the Community in this sector. It is not just sufficient to focus on the financial costs which run to some 42% of the Community budget in agriculture and 28% of the overall Community budget. Some 20% of the producers' milk price is accounted for by this budgetary input. Yet in the light of the foregoing market situation and market return it surely is impossible to justify further expanding milk output on a Community basis.

Policy objectives and constraints

In the light of the above situation the Commission spelt out its objectives and the guidelines within which policy should be formulated over the next years. These policy guidelines are as follows :

a) to stop the increase in milk production,

b) to avoid all measures which run contrary to this objective and, in particular, all aids to investment given by public funds at the Community or national level, which favour higher production and which are still given at the level of the farm and at the level of the processing and marketing enterprises,

c) to put the stress, where possible, on measures which allow the level of consumption to be maintained, to increase the outlets for milk and to reduce the milk production potential,

d) to take the necessary additional measures which will take account of the social situation of small milk producers working in particularly difficult conditions.

The Commission also indicated that these guidelines would be implemented against the background of a number of constraints facing the Community, which effectively limit the possibilities for action. These restraints have been identified as follows :

a) The price relation between milk fat and protein and vegetable fat and vegetable protein which is influenced by the differing levels of external protection.

b) The socio-economic situation of many small producers farming in regions which offer hardly any alternative possibilities.

c) The limited outlets available on the world market, either because of restrictions in certain third countries or because of the high cost of additional exports.

d) The continuation of agri monetary measures.

e) The general economic situation in the Community which is characterised by a high level of unemployment.

Commission proposals

It was in the light of these guidelines and constraints, which seem to be generally understood throughout the Community, that the Commission recently made its proposals to the Council. The essential elements of these proposals are :

1) No price increase
2) Co-responsibility
3) Continuation of non-marketing and conversion premia
4) Temporary suspension of investment aids
5) Aids to consumption.

1) **Price :** Price is an essential element of any policy aimed at reducing the incentives for any increase in output. One may well argue about the degree of response to price but there is little argument about its direction. Individual producers in the short term may well increase output in order to maintain income, but globally the response must be of a classical nature. Maintaining price over a period is an effective decrease in real terms. However, production technology continues to

advance. Hence the impact of a non increase in price is somewhat limited, especially when green rates are likely to change. This in no way detracts from the importance of price in policy formulation and in attempting to bring a better equilibrium between milk output and consumption at a Community level. Although price is an essential and necessary element of policy it is not adequate to deal with the current market situation.

2) **Coresponsibility levy :** In recognizing that price in itself is not adequate as a means of solving the milk problem, the Commission was then faced with a series of options which perhaps could be summarized in the following list :

a) Quota arrangements—global or individual
b) Reduction of intervention prices
c) Levy.

a) **Quotas :** The Commission's view on this point is clearly expressed in COM(78) 430, p. 26, paragraph 48 "Although a system of quotas could have an immediate effect, the Commission is not in favour of such a system. Such measures would be difficult to reconcile with the Community's approach based on free decision and internal trade; it would be almost impossible to construct such a policy without some inequity between different producers or regions of the Community; production quotas tend to fossilize the existing structure; quotas would be extremely difficult to negotiate and even more difficult to change, and consequently there is a risk that in due course there would be a return to surplus production". The substance of that paragraph cannot be refuted but it should be clearly recognized that quotas are a practical approach to the problem. Since they are likely to breakdown to a member state division of entitlements in one way or another, they are therefore likely to be acceptable to a number of member state administrations. Hence those who fear the implementation of quotas should be the first to work towards realistic policy alternatives.

b) **Reduction of intervention prices :** Last year the Commission proposed a temporary suspension of intervention buying for skimmed milk powder during the winter months. It did so in the belief that prices for the skim sector could be maintained without reliance on intervention buying throughout the year. It did so also with a view to removing one of the unnecessarily high cost elements in the milk sector even for a limited period. Other reasons were to encourage people to use liquid skim directly for feeding and to introduce at least some slight element of uncertainty into the milk market. The proposal, though gaining very considerable support in the Council, was not accepted.

The Commission thus examined the related approach of linking intervention buying-in prices to levels of milk output. As milk output increased, buying-in prices would be reduced by a related percentage. Such an approach would be logical economically and would have a direct impact both on producers and consumers. It is the tried and tested classical approach to output problems in an industry. It has the further advantage of being simple and straight forward to administer and control.

It would be the Commission's intention to have had such an approach being adopted to protect the socio-economic weaker sector of the industry from a too drastic change in their situation. Nevertheless, the clear reaction to that option by the member states since the Commission put it forward as a possibility last September has been negative. The intervention system, rather than perhaps the objective which lies behind it, has become sacrosanct.

c) **Levy proposals:** The option chosen by the Commission in the light of the analysis and consultations undertaken is that of a new approach to the coreponsibility levy. The essential elements are as follows:

i) Level would be associated with the changes in milk output on a Community basis. For every one per cent increase in milk output, the levy would be two per cent subject to a continuing minimum of two per cent. Transitional measures would be established for the period 1st June 1979 to 31st January 1980. The reference periods would remain constant thereafter. The elements are shown in Table 1.

Table 1

Link between changes in milk output and level of levy

Reference period	Base period	Application period	Coefficient
1) Calendar year 1977	Calendar year 1978	1.6.79 - 30.9.79	To be determined between 0 and 2
2) 1.2.77 - 31.5.77	1.2.79 - 31.5.79	1.10.79 - 31.1.80	To be determined between 0 and 2
3) 1.6.77 - 30.9.77 1.6.78 - 30.9.78	1.6.79 - 30.9.79	1.2.80 - 31.5.80	2
4) 1.10.77 - 31.1.78 1.10.78 - 31.1.79	1.10.79 - 31.1.80	1.6.80 - 30.9.80	2
5) 1.2.78 - 31.5.78 1.2-79 - 31.5.79	1.2.80 - 31.5.80	1.10.80 - 31.1.81	2

After the transitional period of eight months ending 31.1.1980, the reference periods would remain fixed, the base periods would be moved forward annually. Milk deliveries in the appropriate base period would be compared with the average deliveries in the appropriate reference period and the increase in deliveries in percentage terms would be multiplied by the relevant coefficient to arrive at the level of levy, as a percent of the target price which would be applicable for a further four month period. The ground rules would thus be established by the Council and the system would have a considerable degree of automaticity in the long term while providing for some variability between application periods.

ii) With a view to protecting the income of small producers with few other alternatives to milk production, a system of exemptions on the following basis are provided for :

— principal occupation is farming,

— under 55 years of age or between 55 and 60 years of age and enter into a commitment to cease farming at the age of 60 years, consistant with directive 72/160,

— deliver not more than 60,000 litres of milk per year,

— agricultural holding not more than 25 hectares,

— undertake not to increase their number of dairy cows,

— not have more than one dairy cow per hectare.

This approach can certainly safeguard the income of small farmers while having some deference to the intensity of farming and thereby to the use of concentrates. Commission estimates indicate that when these exemptions are combined with those presently existing in the "hill" regions and southern Italy, some 28 per cent of milk producers delivering some 12 per cent of the milk would in fact be exempt. The corresponding figures in Ireland are 18 per cent and 8 per cent, respectively.

iii) The coresponsibility group would continue to advise the Commission on the promotion, advertising and research programmes which should be continued at about the present level.

iv) Such an approach to the levy is likely in the Commission's view to be effective as a disincentive to further increases in milk output on a Community basis. It is also equitable between producers and makes a great deal of economic sense.

3) **Non marketing and conversion premia :** Though the results todate have not been startling, nevertheless, this programme has had a considerable degree of success. Up to the end of December 1978, some 700,000 cows have been accounted for which reduces the potential for milk output by fairly close to 3%. The response has been very different between member states and even between regions within member states. In general, most people are favourable towards it. Farm leaders and national administratons who strongly favour its continuity and enlargement are particularly impressed with the need for its acceptance, application and encouragement in member states other than their own. This type of programme can be very effective if the premiums are high enough; but also if unemployment benefits were high enough nobody would need to work. Where would the money come from ? However, it is proposed to continue it for another year and to the extent that the total programme proposed by the Commission is adopted by the Council, it is likely to become attractive to a larger group of producers who have some other uses for their available resources.

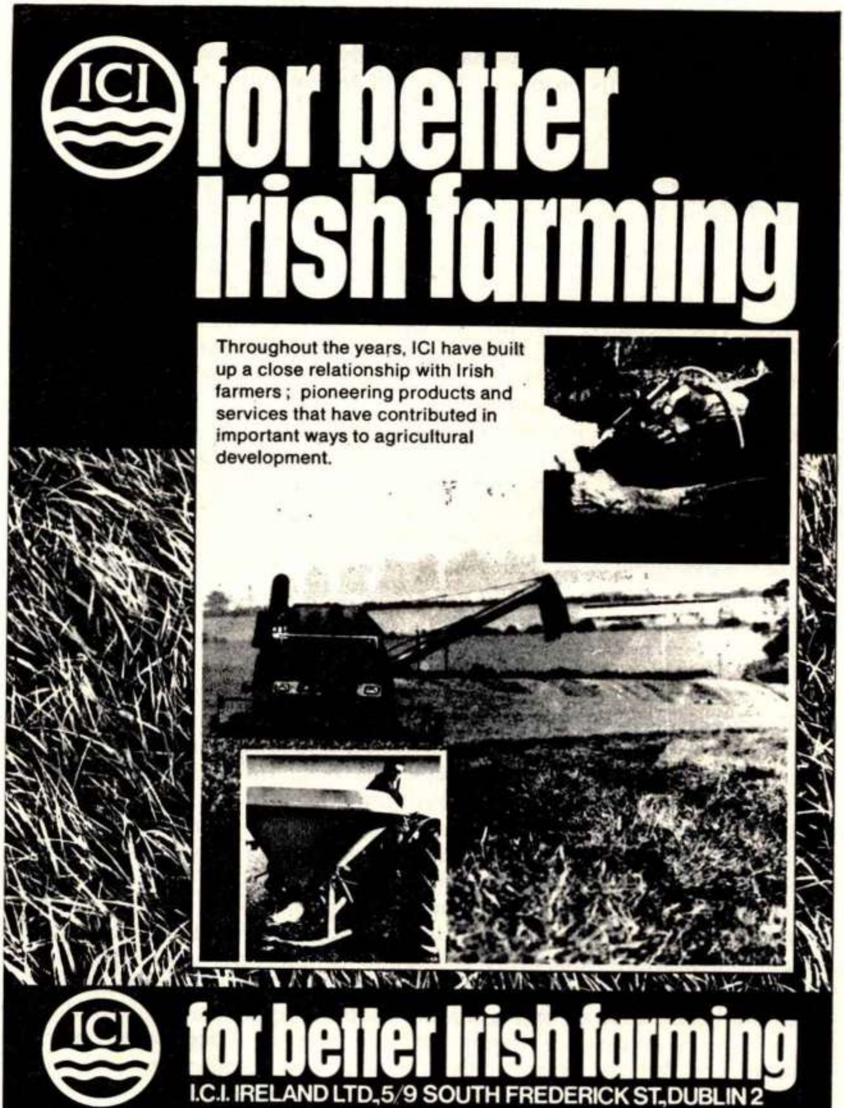
4) **Temporary suspension of investment aids :** It appears totally illogical to continue to use Community and national public funds at farm and factory level to further enlarge the size of the industry at a time when the central objective of any reasonable policy in this sector inevitably has to be to limit its future growth to a minimum. Hence the Commission's proposal for suspension of aids to investment at all levels of the industry,

subject to some exceptions in very particular cases. The proposal is not, as has been suggested, that all investment should cease but that this investment should not be assisted from public funds. It seems even more illogical that the member states (who shall be nameless!) who claim to have a comparative advantage in milk production and who claim to produce milk more efficiently than anybody else, should be foremost in their opposition to this proposal. It would appear to be difficult to defend aids to investment at the manufacturing level in circumstances when most of the aids heretofore granted at that level have yet to be taken up. There is little doubt but that all investment aids in recent years in this sector have led either directly or indirectly to further increases in milk output.

5) **Aids to consumption:** It has already been indicated that adequate measures are now available to meet the requirements as they arise in the skim sector. However the butter sector is the cause of increasing concern as stocks rise steadily. In spite of high export refunds for butter and butter oil, sales at reduced prices for pastry and ice cream manufacture, sales to armies and non-profit making institutions, for the manufacture of butter concentrate and reduced prices for butter for people on social assistance, some further measures are clearly necessary. Short term sales at reduced prices, the so-called Christmas butter schemes, were reasonably successful in 1977 and 1978—but much more so in the former than the latter. In view of this, the Commission is proposing an enlarged general butter subsidy scheme. Whereas under present legislation, if member states grant a butter subsidy of 56 u.a./100 kg, the Community contribution is 23 u.a. On the basis of the Commission's proposal, at the level of 56 u.a., the Community contribution would be 42 u.a./100 kg. Such a scheme should be attractive to a number of member states besides those already implementing the butter subsidy scheme.

Implications for Irish dairying

The above paragraphs outline the environment within which, on the basis of the Commission's proposals, the Irish dairy industry will be operating in the future. It is an environment where prices in real terms shall decrease somewhat and where aids to further investment shall be considerably limited. It is also a situation where a levy on milk, associated with the level of changes in milk output at the Community level, will become an integral part of Community policy. The level of the levy should be such as to provide a real disincentive to further increases in global milk output. Small farmers, with no other alternatives, will find their income situation adequately protected. Milk will continue to be a profitable business at all levels for those operating efficiently. Total output will to a continuing degree have to be associated with market requirements. Producers under the above proposals can plan on a sound and constructive policy being implemented well into the future providing adequate scope for enterprise and technical and managerial ability. The policy provides for equity between producers right throughout the Community under their varying circumstances and thus taking into account their long-term interests.



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EIGHTH EDWARD RICHARDS-ORPEN MEMORIAL LECTURE

Some Aspects of Recent Research in Dairying

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Introduction

I would like to sincerely thank the Trustees of the Edward Richards-Orpen Memorial Trust for inviting me to present this Eighth Memorial Lecture. When I received the invitation I recognised that it would not be an easy task to present a lecture fitting to the memory of such a person as Mr. Richards-Orpen about whom I have read so many tributes. Nevertheless I felt that I must accept the invitation if the dairy industry is to benefit from the total research effort which is being expended under the the favourable grass-growing conditions which we enjoy throughout Ireland. Indeed it is because of this importance of grass in our ruminant based systems that so much of the nutritional research work carried out in other countries, such as Great Britain, is of relatively little direct value in our environment.

The tremendous potential for grass growth, and hence animal production, from grassland in Ireland has been recognised for many years but, even yet, I do not think that this is fully appreciated let alone exploited. For example, the yields of grass dry matter recorded in variety testing work at Crossnacreevy near Belfast is 60 per cent greater than the average of the other sites for similar trials throughout the United Kingdom (1).

When research in dairying was initiated at Hillsborough ten years ago it was considered that the major effort must be devoted to exploiting this potential of grass or grass products. During this period a number of different aspects have been investigated, but I intend to speak only on the following three areas:

1. Development of a spring-calving system.
2. Silage quality.
3. Protein nutrition on indoor diets.

While the research work carried out under 1 above has been concerned solely with a specific system, that under 2 and 3 has been of a more general nature and has implications for dairy management irrespective of season of calving.

1. **Development of a spring calving system**

In any grass-growing environment in which efficient milk production is required it is obvious that a system which attempts to match the changing requirements of the dairy cow throughout it's lactation to the quantity

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and quality of the feed available must be of major importance. This is the basis of the spring-calving system and for this reason a considerable part of our research programme at Hillsborough has been devoted to developing such a system. However, as all those involved in research are aware, a research programme aimed at establishing optimum systems for any type of animal production is extremely difficult. This difficulty arises not only because of the problems brought about by the large scale and long-term nature of the trials, but also because some basic assumptions must be made when establishing the 'bare framework' of the system on which to build the details. In the present context the basis framework consisted of making broad decisions on the calving pattern to be adopted, the time at which animals are likely to be able to go to pasture in the spring and the type of conserved grass to be used for winter feed. An example of the implications of these decisions is demonstrated by the fact that if a research programme was superimposed on a system based on hay as against silage for the winter feed this would affect the answers which would be obtained to questions such as what is the optimum level of nitrogen fertiliser and optimum concentrate inputs. We assumed that the basic system would have the following framework:

1. Due to ground conditions prevailing in the North of Ireland animals will require to be maintained indoors for a minimum period of five months and will not be at pasture until early or mid-April.
2. Grass conserved as silage should be the basal winter diet as it allows a greater exploitation of the growth potential of grass.
3. Calving should commence on January 1st and be as compact as possible thereafter.

The decision to calve early, relative to the onset of the grazing period, was based primarily on the fact that information produced by Wood (2) from a survey of milk yield data from the Milk Marketing Board for England and Wales demonstrated that there was a consistent decline in lactation yield with progressively later calving after January. This was later confirmed in an analysis of data from Hillsborough (3) which showed a mean decline in lactation yield of 220 kg for each month's delay in calving between January 1st and April 1st. A relatively similar decline of 180 kg/month has been reported by Cunningham (4).

Commencing with this basic system, revolving around block-calving starting on January 1st, giving grass silage as the basal diet during the winter period and grazing pasture from early April until grass growth declines or land becomes too wet for grazing in the autmn, the object has been to establish the optimum inputs of some of the major variables in the system. These include the amount of nitrogen fertiliser which should be applied to the grass, the stocking rate to be used and the quantity of concentrate required to supplement the basal diets of silage or grass.

Nitrogen for grazed pasture

The optimum level of any input is dictated by the cost of that input relative to the value of the product produced, coupled with the response relationship between the input and the product output. In the case of fertiliser nitrogen this response relationship has been the subject of more discussion and debate over the past 20 years than probably any other input. The response to nitrogen has been measured in terms of grass dry matter output in many grass cutting experiments, but a smaller number of experiments have been designed to assess the response in terms of animal output either as milk or beef. Currently our thinking is based on the results from a three year trial, carried out by my former colleague Roger Marsh at Hillsborough (5) during the early 1970's, in which he characterised the relationship between nitrogen input and beef output. This relationship indicated that a substantial response in animal product was obtained up to about 400 kg nitrogen per hectare. In earlier work (6) carried out with dairy cows, again over a three year period, grazed on pasture receiving 400 and 700 kg nitrogen per hectare a marginal increase of only 7 per cent in milk output at the higher nitrogen level was detected. The combination of these two studies led us to the conclusion that the optimum nitrogen input for grazing under intensive stocking conditions was likely to be of the order of 400-450/kg per hectare and this, therefore, was the level adopted in the system. It is recognised, however, that this recommendation is not in line with recommendations in the Republic of Ireland and this is a source of some concern. For example McFeely, Butler and Gleeson (7) have recommended a maximum nitrogen input of 250 kg per hectare with intensive dairying, while Collins, Drennan and Flynn (8) have stated that it is difficult to recommend levels of nitrogen above 120 kg per hectare for beef cattle. This disparity in recommendations cannot be taken lightly and because of its importance we hope in the present year to re-examine the response to nitrogen through the dairy cow.

Nitrogen for conserved grass

As ground conditions in Northern Ireland require that dairy cows be housed for a period ranging from 5 - 6 months each year there is a very large requirement for conserved forage. In the practical context this may best be achieved through the use of specialised conservation area managed separately from the grazing area rather than trying to integrate conservation and grazing into a single system. With this approach the optimum nitrogen input for conservation can be determined directly from cutting trials and an example of the results obtained from one such trial carried out at Hillsborough (9) is given in Table 1.

Table 1
Effect of level of nitrogen on grass dry matter yield

Level of N (kg/ha)	Grass DM output (kg/ha)
0	6730
200	9910
400	12570
600	14290
800	14730

From results of this type it has been concluded that the response of cut herbage to nitrogen is considerable, even to levels above 400 kg per hectare, and that this sort of level can be readily adopted for conservation.

Stocking rate at pasture

The optimum stocking rate in any dairying system will obviously be a function of the quantity of grass which can be produced per hectare and the nutritional requirements of the animals utilising this grass. With the levels of nitrogen used at Hillsborough relatively high yields of grass dry matter are achieved with amounts of around 11,000 kg dry matter per hectare consumed by cows being regularly recorded (10). If a metabolisible energy value for grass of 11.5 MJ per kg dry matter is assumed, the level of grass energy output per hectare should be capable of supporting around 5.0 cows producing an average daily milk yield over the the grazing period of 15 kg, while at the same time gaining in bodyweight at the rate of 0.4 kg per day (using the ME requirements of Friesian cows as given by MAFF, DAFS and DANI) (11). In the first two years of our stocking rate experiments rates of 6.4 and 4.9 cows per hectare over the grazing season (3.2 and 2.7 cows per hectare including the conservation area) were examined (12). The results obtained from these are given under Experiment 1 in Table 2.

Table 2

Effect of stocking rate on milk output per cow and per hectare

Experiment 1 (mean of 2 years)		
Stocking rate at pasture (cows/ha)	6.4	4.9
Milk output kg/ha)	16502	14064
Milk output/cow at pasture (kg)	2571	2847
Overall stocking rate—including conservation (cows/ha)	3.2	2.7
Experiment 2 (mean of 2 years)		
Mean stocking rate at pasture (cows/ha)	5.6	4.3
Milk output (kg/ha)	16985	13893
Milk output/cow at pasture (kg)	2963	3181
Overall stocking rate—including conservation (cows/ha)	3.0	2.5

In summary it was found that, while the output of milk produced per hectare of grazing area was increased by 17 per cent through the use of the higher stocking rate, performance per animal was reduced by about 11 per cent. From these results it was concluded that, while the higher stocking resulted in a very high milk output of over 16,500 kg per hectare, the depression in performance per cow at 276 kg was too great to be used in the practical context. However when the lactation curves of both groups were compared, it was apparent that the use of a high stocking rate in early season did not reduce milk output during that period and that the reduction in milk yield per animal only occurred from late June onwards. This led to the approach of maintaining high stocking rates of about 6.4 cows per hectare during the early part of the grazing season and reducing this in steps as the rate of grass growth declined by introducing additional land from the conservation area to finish at around 4.9 cows per hectare by late September. By this approach a high output of milk per hectare can be achieved without depressing the performance of the individual animal too severely. An example of the results obtained using this method is given in Table 2 (Experiment 2), in which the mean stocking rate of 5.6 cows per hectare was obtained by the system outlined of starting the grazing season at 6.4 cows per hectare and finishing at 4.9 cows per hectare (10). These results indicate that a very high level of milk output per hectare at 16,985 kg could be produced with a depression in individual animal yield of about 7 per cent.

While the approach outlined above goes some way towards producing high outputs of milk per hectare without reducing yield per cow too severely, it must be recognised that the conflict between high output per hectare and high output per cow remains one of the major problems in grass utilisation and the problem is likely to increase as we steadily move towards higher yielding cows.

There have been various attempts to solve this problem by manipulation of the grazing system. Examples of this have been the adoption of systems which allowed the higher-yielding cows to selectively graze ahead of lower producers and the use of systems which alternated grazing and cutting. Neither of these approaches seem to offer much hope of success. An experiment has also just been completed at Hillsborough investigating another approach (10). To achieve high outputs of milk per hectare requires firstly good grass growth and, secondly, that grass is grazed fairly severely to ensure that most of the grass is utilised. However it is known that grazing herbage severely reduces grass intake per cow and hence milk output per cow. It was felt, therefore, that if a system was used which only severely defoliated the sward at intervals rather than at each grazing the depression in yield per cow might be lessened. In the experiment a conventional system, which involved a severe defoliation at each grazing, was compared with two systems in which the sward was severely defoliated at either alternate or every third grazing. All three systems were maintained at equal stocking rates. The preliminary results are given in Table 3.

These results show no advantage for either of the two experimental grazing systems. In 1977, when the stocking rate was sufficiently high to depress yield per animal by 10 per cent on the conventional system, there appeared to be some advantage from the system where severe defoliation was carried out at every third grazing. A similar effect was not obtained in 1978 but this may have been due to good grass growth in that year resulting in a low depression in yield per cow at the higher stocking rate of only 4 per cent. It seems unlikely, therefore, that this approach of alternating lax and severe grazing will offer any scope for improvement although I feel that the general concept still merits some research consideration.

Table 3

The effect of grazing system on output per cow and per hectare

Grazing system	Conventional		Frequency of severe defoliation of paddock	
1977	Low stock	High stock	Alternate cycles	Every 3rd cycle
Stocking rate (cows/ha)	4.3	5.6	5.6	5.6
Milk output (kg/ha)	13678	16286	16472	17072
Milk output (kg/cow)	3144	2823	2858	2980
Weight change (kg/cow)	+25	+ 7	+ 0	+ 5
1978				
Stocking rate (cows/ha)	4.4	5.7	5.7	5.7
Milk output (kg/ha)	14107	17684	17866	17298
Milk output (kg/cow)	3218	3102	3126	3025
Weight change (kg/cow)	+15	− 1	− 3	− 1

Level of concentrate supplementation during the indoor period

Where the winter diet of the spring-calving cow is to be based on silage the nutrient requirement of the fresh calved animal will exceed those that can be supplied from silage alone and the deficiency has to be remedied by the use of supplementary concentrates. However the question of how much concentrate to feed during this period is continually a matter for debate. It could be argued that the quantity can be determined simply from a calculation based on the theoretical requirements of the animal and a knowledge of the nutritive value of the feeds. While such an approach may satisfy the nutritionist it may not necessarily provide the correct answer in terms of economics. This can only be determined by firstly establishing the way in which the animal will respond to a change in concentrate input and from this deciding the optimum economic level of supplementation. A series of three experiments has been carried out at Hillsborough in order to provide data on the response in milk output to a change in concentrate input. In all of these studies cows have had *ad libitum* access to medium-good quality grass silage with "D"-values of the order of 65 - 67 and metabolisable energy contents of about 10.0 MJ per kg dry matter. No concentrates were given prior to calving and in each year the animals have calved from early January until early March, with a mean calving date of between January 18 - 25th in any year. In each year the animals went to pasture during early-mid April.

In Experiment 1 three levels of concentrate of 3.8, 5.5 and 7.2 kg per day were used from calving until going to pasture in each of two years (13). At pasture the cows were grazed at a mean stocking rate of 5.5 cows per hectare without any concentrate supplementation other than for 7 - 10 days after turn out in the spring. The results obtained are given in Table 4.

Table 4

Effect of level of concentrate supplementation indoors on performance

Experiment 1			
Mean concentrate input (kg/day)	3.8	5.5	7.2
Milk yield indoors (kg)	1732	1860	1959
Milk yield at pasture (kg)	2996	3064	3266
Total lactation yield (kg)	4727	4919	5224
Liveweight at end of lactation (kg)	609	609	600
Experiment 2			
Mean concentrate input (kg/day)	7.0	9.5	
Milk yield indoors (kg)	1971	2064	
Milk yield at pasture (kg)	2739	2679	
Total lactation milk yield (kg)	4984	4991	
Liveweight at end of lactation (kg)	600	612	
Experiment 3			
Mean concentrate input (kg/day)	7.2	10.5	
Milk yield indoors (kg)	1870	1924	
Milk yield at pasture (kg)	3470	3312	
Total lactation milk yield (kg)	5451	5366	
Liveweight at end of lactation (kg)	606	606	

Increasing the concentrate input not only increased milk yield indoors but also resulted in substantially more milk being produced at grass. The overall effect was therefore that the higher concentrate input provided the greatest economic return.

In Experiment 2 a higher level of supplementation of 9.5 kg per day was compared with that of 7 kg per day which had been found to be best in the previous trial (12). Again the experiment was carried out over a two year period and the animals were grazed at a mean stocking rate of 5.7 cows per hectare. The results in Table 4 show that, while the higher level of concentrate feeding indoors increased the quantity of milk produced during the indoor period, it did not improve total lactation yield because the animals on the higher level of supplementation tended to produce less at pasture. The result was obtained even though theoretical calculations of nutrient requirements indicated that the higher level of supplementation was the more nutritionally correct diet.

Because of the scepticism for these results displayed by those concerned with high concentrate inputs a further experiment was undertaken to examine further high concentrate inputs (14). In this trial (Experiment

3) 7.2 kg per day of concentrate was compared with a higher input than that used previously at 10.5 kg per day. The results obtained are given in Table 4. Again the higher concentrate input increased milk output indoors, but reduced the subsequent performance at pasture with the net effect being that total lactation yield was not improved.

The conclusion from this series of experiments must be that when good quality silage, given *ad libitum,* forms the basal diet the optimum level of concentrate supplementation is around 7.2 kg per day. Higher levels than this cannot be justified even with animals giving 5,100 kg milk per lactation, which is the mean yield of all animals used over the five year experimental programme.

Pattern of concentrate supplementation

The research work described previously had clearly established the optimum level of concentrates. However the question arises as to whether concentrates should be allocated at the same level per day from calving until going to pasture or whether it would be better to allocate more concentrates immediately post-calving in order to stimulate production at the commencement of lactation. For example Broster and his colleagues at the National Institute for Research in Dairying (15) have suggested that improved feeding during the first four weeks after calving has a substantial beneficial effect on production throughout the remainder of the lactation. A two year experiment was therefore undertaken to compare a flat-rate feeding system in which each animal received the same level of concentrates per day from calving until going to pasture with a high/low system in which much higher amounts of concentrates were given during the first four weeks after calving (14). All animals had access to the same silage and the total input of concentrates was similar. The results are given in Table 5.

Table 5

Effect of pattern of concentrate allocation after calving

Concentrate allocation system	Flat rate	High/low
Total concentrate input (kg)	412	402
Milk yield indoors (kg)	1851	1848
Milk yield at pasture (kg)	3170	3048
Total lactation yield (kg)	5021	4893

These results showed that adopting a high/low system had no beneficial effect on either the amount of milk produced indoors or during the total lactation. This, therefore, eliminates the need to use high concentrate inputs during the post-calving period when digestive upsets are frequently encountered.

In this comparison all animals within each treatment received the same amount of concentrates irrespective of the yield of the individual cow. In a further experiment a flat-rate feeding system in which all animals received the same quantity of concentrates was compared with a high/low system in which the concentrate input for each animal was related to its milk yield with high yielding animals receiving more and low yielders less concentrate (16). The effect on milk yield is shown in Table 6.

Table 6

Comparison of a flat rate system with a high/low system in which concentrates were allocated according to the yield of the individual cow

Concentrate allocation system	Flat rate	High/low
Total concentrate input (kg)	447	440
Milk yield indoors (kg)	1946	1954
Mean yield after 10 wks. at pasture (kg/d)	18.4	18.5

There was no effect of system of allocation on milk output during the indoor period and, while the experiment did not embrace a full lactation, the performance during the first ten weeks at pasture did not show any difference in residual effects.

The results of this and the previous experiment show that with a spring calving system a uniform daily feed allowance, irrespective of stage of lactation and milk yield potential of the individual cow, will produce equivalent results compared with more complicated systems which either aim to achieve high peak yields or allocate feed according to milk yield.

Concentrate supplementation at pasture

The use of concentrates as a supplement for dairy cows at pasture has been a feature of the U.K. dairy industry for many years. This practice has been founded on a continual attempt by the dairy farmer to provide for the nutritional requirements of the lactating animal. However it must be appreciated that the short term nutritional requirements of the animal are of much less importance than is the economic response to any additional feed given, provided the long term nutrition and health is not impaired. Leaver, Campling and Holmes (17) reviewed the results from experiments in which the response in milk yield to concentrates given at grass had been assessed and, in general, the results indicated that between 2 to 5 kg concentrates were required to produce an extra 1 kg milk. However most of the experiments were conducted with cows which were not in early lactation and high yielding with the result that critics have suggested that the findings may not be applicable to the higher-yielding, spring-calving cow. For this reason an experiment was carried out at Hillsborough to examine the response from cows calving during March and April (18). These cows were producing on average 28 kg milk per day prior to going to pasture and were grazed together as a single group at a stocking rate of 5.5 cows per hectare throughout the experiment which lasted for 14 weeks. The cows were given three levels of cereal-based supplement of 0.45, 2.25 and 4.05 kg per day. There was a good supply of grass available throughout the experiment. The mean performance over the period is given in Table 7.

Table 7

The effect of feeding supplementary concentrates at pasture to March-April calving cows producing 28 kg milk per day when going to pasture

Concentrate intake (kg/day)	0.45	2.25	4.05
Mean milk yield (kg/cow)	23.6	23.6	24.8

These results show that even with high-yielding, spring-calving cows the response to additional concentrates when ample grass is available is extremely low. It has now been shown conclusively that the major reason for this small response to supplements at grass is due to the supplement depressing the intake of herbage by the animal with the net result that the total nutrient intake is only marginally increased. It has been argued that, while cereals result in a considerable depression in herbage intake, the effect could be reduced by using supplements which are more complementary to the digestion of forages in the rumen. Dried grass was felt to be a possibility and some work has been carried out at Hillsborough to examine if the inclusion of this forage in the supplement mix, or giving a sole supplement of dried grass, would improve performance (19). In essence the results have shown that neither the use of dried grass on it's own nor it's inclusion as a proportion of the supplment has improved the response at pasture.

The above results demonstrated clearly that when there was a reasonable supply of grass, concentrate supplementation, even to high-yielding animals, was of no economic benefit. However there are occasions when grass is in short supply and it seems likely that in such circumstances the response to supplementation would be greater. Such circumstances arose during the very dry summer period in 1976 when the rate of grass growth was extremely low. During this period of grass shortage a trial was set up to assess the effect of providing supplementary feed (20). Three treatments were applied to a group of cows grazing as a single group at a stocking rate of approximately 4.5 cows per hectare. In one treatment no supplement was provided while in the other two treatments 4 kg per day of a supplement containing 9 or 21 per cent crude protein was given. The results obtained are given in Table 8.

Table 8

Effect of concentrates containing two levels of protein to first lactation cows at pasture with restricted grass supply

Level of concentrate feeding (kg/d)	0	4	4
Protein content of concentrate (%)	—	9	21
Milk yield (kg/day)	14.2	16.6	17.5
Liveweight (kg)	455	458	458

The milk yield response to both supplements was considerably greater than those normally reported due to the very limited supply of grass available. However even in such circumstances the response of 0.6 and 0.8 kg milk per kg of concentrates for the high and low protein supplements respectively did not increase the profitability of milk production. It may, however, be worth noting that the response tended to be greater with the higher protein supplement and this is an area which could merit research work if for any reason in the future supplements should be used at pasture.

Performance of spring-calving system

The foregoing discussion has been concerned with an examination of the individual components of the spring-calving system. However throughout this experimental programme attempts have been made to incorporate each aspect into an overall system of management for the existing herd. The system now adopted therefore incorporates these research findings. Basically this implies a block-calving programme commencing at the beginning of January and aiming for completion by early March. No concentrates are given prior to calving and all animals are given a uniform concentrate input of 7.2 kg per day, irrespective of yield potential or lactation number, from calving until going to pasture. Grazing commences during early to mid-April at a stocking rate of 6.4 cows per hectare during the early season decreasing in steps to reach 4.9 cows per hectare by early August and with about 430 kg N per hectare being applied over the grazing season. No concentrates are given at pasture, except during the first 7 - 10 days after turnout, and from early October when all lactating animals receive 1.6 kg per day until drying off. Animals are housed with *ad libitum* access to silage from October or November. The performance for the herd during the 12 month period ending December, 1978, embracing all experimental treatments is given in Table 9.

Table 9

Performance of the Hillsborough spring calving herd for the year ending December, 1978

Mean number of cows	102
Stocking rate (cows/ha)	2.9
Nitrogen input (kg/ha)	390
Concentrate input (kg/cow)	550
Milk output cow (litres)	5344
Milk composition	
Butterfat (%)	4.10
Solids-not-fat (%)	8.97

This performance indicates that there is considerable potential for achieving relatively high milk yields per cow with only moderate concentrate inputs and is the basis for a very sound dairying industry.

Rearing replacement heifers

While the management of the dairy cow during the productive period of her life has been the major area of research work carried out at Hillsborough, an attempt has also been made to provide information on the rearing of the replacement stock for the spring-calving system. At the outset it was realised that, with the relatively small numbers of replacements being reared per year at the Institute, there was little point in becoming involved in some of the major problems such as age or weight at calving. Instead the approach was adopted that we could achieve best results by using all available information from other centres throughout the world on these basic questions and use our resources to evaluate how the present target performance could be best achieved within a grass environment. The targets which have been assumed are that two year old calving is essential on economic grounds and that, if adequate lactation performance is to be achieved, a pre-calving liveweight of over 500 kg is required. Furthermore to achieve an adequate conception rate a liveweight of over 300 kg at mating is required and, indeed, if the pre-calving target of 500 kg is to be met it is preferable that animals are approximately 320 kg at mating. The problem in such rearing systems has always been that of achieving adequate growth during the early months of the animals life. A series of experiments has therefore been carried out to examine some of the factors which might affect performance during this period.

Effect of date of turnout to pasture during the first year

In Northern Ireland weather conditions are generally unsuitable to allow young calves born during the spring to go to pasture before mid to late April. An experiment was therefore carried out to examine whether these animals should go to pasture at this stage or, alternatively, be retained indoors for a further period in an effort to achieve higher liveweights before going to pasture. The experiment was run for two seasons, in each season animals were put to pasture either during late April, late May or late June. In each case no concentrates were given throughout the grazing period which lasted until mid-October. The groups retained indoors received 2 kg concentrate per day in addition to grass silage. At pasture all calves grazed together as the leader group in a leader-follower system. The mean results over the grazing period are given in Table 10.

Table 10

Effect of date of going to pasture during the first grazing season on the performance of spring born heifer calves

Date to pasture	Late April	Late May	Late June
Liveweight during late April (kg)	96.3	95.9	96.5
Liveweight during late May (kg)	114.1	123.6	124.2
Liveweight during late June (kg)	129.8	131.4	153.4
Liveweight in October (kg)	228.3	232.9	219.9

During the extra period when the animals were maintained indoors they grew considerably faster than the group which went to pasture early. However, when these groups went to pasture their subsequent performance was considerably poorer than the group that had already been at pasture. The result was that by the end of the grazing season the group put to pasture early was of similar liveweight to the other two groups and had consumed considerably less concentrates during the rearing period. In addition the management at pasture had been much easier than when the animals were retained indoors.

From this experiment it was found that where animals were given no supplementary feed during the pasture period a total input of concentrates of approximately 375 kg per animal was required in addition to silage of 63 "D" value during the yearling winter to achieve a mean liveweight at mating of 320 kg. The question arose as to whether providing some of this concentrate during the previous grazing period would result in a better overall performance. An experiment was set up to examine the effect of providing differing proportions of the concentrate during the grazing period, but maintaining a constant level of total concentrate input per animal up to mating. Four treatments were applied with animals getting 0, 15, 36 or 57 per cent of their concentrates during the pasture period and the remainder during the following winter. All animals were grazed as a single, leader group at pasture and had *ad libitum* access to silage of approximately 63 "D" value during the following winter. The results are given in Table 11.

Table 11

Effect of feeding concentrates to spring born heifer calves during the first year at pasture

% concentrates given at pasture (kg)	0	15	36	57
Initial wt. to pasture (kg)	77.6	78.5	77.3	78.0
Weight at end of grazing season (kg)	210	206	213	223
Weight at end of winter period (kg)	341	333	324	332
Total concentrate input (kg)	386	383	379	375

Supplementary concentrates at pasture resulted in a slight improvement in liveweight gain at pasture, but the response was small. By the end of the following winter the group which had received all its concentrates indoors was heavier than any of the other three groups, indicating that when adequate high quality pasture is available concentrate supplementation should be limited to the indoor, winter-feeding period.

Type of concentrate given indoors

A further trial has been completed to assess the effect of protein content of the supplement given in addition to silage during the yearling winter. Two supplements consisting of either a barley/mineral mixture, containing 9 per cent crude protein, and a barley/soyabean mixture, con-

taining 15 per cent crude protein, have been compared. Both were given in equal amounts of 2.1 kg per day. The effects on silage intake and final liveweight at the end of the winter are shown in Table 12.

Type of supplement did not affect either silage dry matter intake or the liveweight of the animals at the end of the winter period, indicating that

Table 12

Effect of protein content of the concentrate given during the yearling winter to spring born replacement heifers

Protein content of concentrate (%)	9	15
Liveweight at commencement of indoor feeding period (kg)	241	240
Mean silage intake (kg DM/day)	5.10	5.2
Concentrate intake (kg)	2.1	2.1
Liveweight at end of indoor feeding period (kg)	366	366

the cheaper supplement consisting of barley and minerals is adequate as a supplement for silage during the yearling winter.

Length of dry period at end of first lactation

With spring-calving animals in their first lactation there is a tendency for body condition to decline considerably during the pasture period, with the result that the condition of these animals at the end of lactation is generally below that of the mature cow managed in the same system. The question arises as to whether this relatively poor body condition will affect subsequent performance and, if it does, how can it be improved. One approach is to increase the length of the dry period by terminating the first lactation at an earlier date. An experiment is in progress at the Institute to examine the effect of drying animals off four weeks earlier than normal. The preliminary results from this are given in Table 13.

Table 13

Effect of extending the dry period after the first lactation

System	Normal dry period	Extended dry period
Length of dry period (wks.)	8	12
Condition score at drying-off	1.8	1.8
First lactation yield (kg)	4701	4373
Condition score at 2nd calving	2.3	2.8
Second lactation yield (kg)	5084	5351
Total yield 1st and 2nd lactation (kg)	9785	9724

Drying the animals off four weeks earlier than normal increased the following lactation yield by 261 kg. However an approximately similar quantity of milk was lost from this group during the first lactation, due to the early drying-off, with the effect that total production assessed over the first two lactations was unaffected. However this study will continue and will be extended into subsequent lactations to establish whether there is any further residual effect.

2. **Silage Quality**
Interval between regrowths

The optimum re-growth interval for grass for silage has been the subject of considerable debate and the purpose of some of our work has been to establish the effect of different re-growth intervals on milk production. To date two experiments have been completed. In the first experiment re-growth intervals of 5 and 9 weeks were compared using a predominantly perennial ryegrass sward (21). The resulting silages were offered *ad libitum* to lactating cows with the same quantity of concentrate being given with each silage. The effect of these treatments on intake of silage dry matter, milk yield and liveweight at the end of the experiment are given under Experiment 1 in Table 14.

Table 14

Effect of interval between silage harvests on performance

Experiment 1			
Interval (wks.)		9	5
Silage DM intake (kg/d)		8.5	9.4
Milk yield (kg/d)		25.1	27.6
Liveweight (kg)		537	549
Experiment 2			
Interval (wks.)	9	7	5
Silage DM intake (kg/d)	7.8	8.4	10.4
Milk yield (kg/d)	26.3	28.2	29.0
Liveweight (kg)	511	530	528

Reducing the regrowth interval from 9 to 5 weeks resulted in an 11 per cent increase in silage dry matter intake and 2.5 kg per day in milk yield. In the second experiment three silages made after regrowth intervals of 5, 7 and 9 weeks were assessed by again offering the silages to dairy cows receiving 7.2 kg concentrates per day (21). The results are given under Expediment 2 in Table 14. The effect on intake in this trial was greater than in the previous one with a 33 per cent increase in silage dry matter intake being obtained by decreasing the regrowth interval from 9 to 5 weeks. The effect on milk yield however was similar to that obtained in Experiment 1.

Effect of wilting prior to ensiling

A total of three experiments have been carried out to examine the effect of wilting prior to ensiling on the milk producing potential of the resulting silage (21). In all experiments the unwilted herbage was ensiled within 15 minutes of being mown by rotary mower and all silages were made with a precision-chop harvester. All silages had formic acid (Add-F, B.P. Chemicals Ltd.) applied at the rate of approximately 2.2 litres per tonne of herbage ensiled. The length of time required to achieve the required degree of wilt varied between 1 and 5 days in the three experiments. Within each experiment cows on both treatments received the same level of concentrate supplementation on a fixed daily basis.

The results of the three experiments are given in Table 15.

Table 15
Effect of wilting of silage on the performance of dairy cows

	Unwilted	Wilted
Experiment 1		
DM content of silage (%)	23	35
Silage intake (kg DM/d)	9.4	9.7
Milk yield (kg/d)	27.6	27.5
Experiment 2		
DM content of silage (%)	23	47
Silage intake (kg DM/d)	8.9	9.7
Milk yield (kg/d)	27.8	26.5
Experiment 3		
DM content of silage (%)	22.6	39.0
Silage intake (kg DM/d)	8.8	9.7
Milk yield (kg/d)	23.3	22.8

In Experiment 1 wilting to 35 per cent dry matter slightly, but not significantly, improved the intake of silage dry matter but had no effect on milk yield. In the second experiment wilting to 47 per cent dry matter increased silage intake by 11 per cent, but significantly depressed milk output. In Experiment 3 wilting to 39 per cent dry matter resulted in an increase in silage intake of 10 per cent, but had no effect on milk yield. Over the three experiments wilting increased intake on average by 8 per cent and reduced milk yield by 2.5 per cent or 0.6 kg per day.

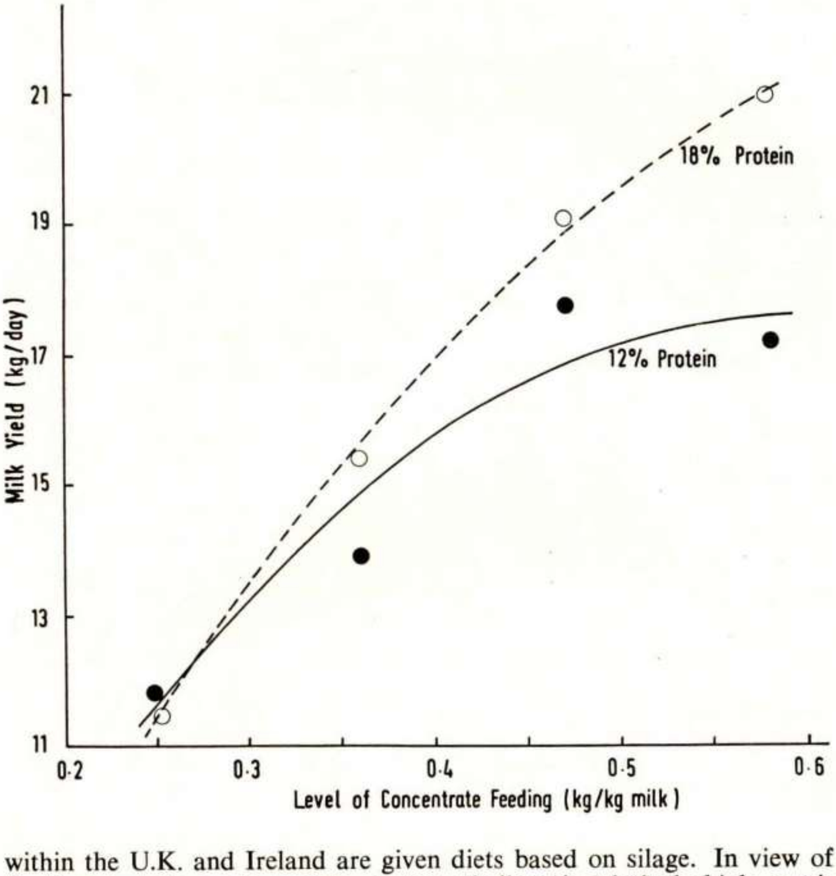
While such results do not give much encouragement for wilting there are however two factors which should be remembered. Firstly fairly heavily wilted silages were used in all three experiments and it is still open to question as to whether a response might not be obtained with more moderate degrees of wilting, for example to 25 - 28 per cent dry matter. An experiment is in progress at present to provide data on this point. Secondly, even if no benefit is obtained in terms of animal production from wilting, this does not in itself imply that wilting should not be carried out. The whole concept of wilting is much more complex than the effect on animal production and involves pollution, mechanisation, speed of harvesting, ease of handling, these being aspects which each farmer must take into account in making decisions on the value of wilting. I also feel, however, that there are areas within silage making which have not to date been sufficiently researched to enable the farmer to make rational decisions. These include the question of the effects of silage-making machinery and harvesting techniques on the losses incurred in silage making and subsequent production of the sward.

Protein nutrition on indoor diets

Over the past 20 - 30 years a considerable volume of research work has been carried out on the effect of level of protein intake on milk output. In summary it could be said that little response has been obtained to increasing protein intake above that required to meet theoretical requirements. However, there are two aspects which must be borne in mind before concluding that all the answers are known. Firstly, the bulk of the evidence has been derived from experiments in which different protein levels have been compared on diets which supplied theoretical energy requirements and, secondly, hay has generally been the basal diet. With regard to the first point there is now sufficient evidence to show that there is an interrelationship between the response to providing additional protein and the level of energy intake (22). For example, Fig. 1 shows the effect on milk output of giving concentrates of two protein contents over a range of feeding levels ranging from 0.25 - 0.58 kg per kg milk. These data were obtained using cows given two concentrates containing either 12 or 18 per cent protein in addition to a basal diet of hay which supplied maintenance energy and protein requirements. The important aspect of these results was that at low rates of concentrate supplementation no benefit was obtained from using a concentrate containing more than 12 per cent protein even though this theoretically represented a severe deficiency in protein. However, as the amount of concentrates was increased the increase in milk yield obtained from using the higher protein level became larger and was greatest at the highest level of concentrate input. The results also show another important point which is that a given level of milk yield could be supported by giving two protein concentrates at different rates. For example, the 18 per cent protein concentrate given at the rate of 0.4 kg per kg milk supported a yield of 16.9 kg per day which, in turn, could alternatively have been supported by giving the 12 per cent protein concentrate at the rate of 0.48 kg per kg milk. This demonstrates that there may be a degree of substitution between protein content and feeding level in the practical situation, which can become very important as the relative prices of protein sources and cereal grain change.

The work involving intake discussed above was carried out with a basal diet of hay. However, the majority of cows on progressive farms

Fig: 1 The Effect on Milk Yield of using a Concentrate Containing either 12 or 18% Protein at Different Rates of Feeding



within the U.K. and Ireland are given diets based on silage. In view of the fact that the crude protein content of silage is relatively high, nutritionists would argue that a low protein supplement would provide for theoretical protein requirements. There is, however, a growing volume of evidence to question this concept. For example, Table 16 shows the results from an experiment in which cows were given similar amounts of four concentrates, but with the concentrates varying in protein content from 10 to 21 per cent (23). All four concentrates were given in addition to a basal diet of wilted grass silage with a "D" value of 67.

While in theory adequate protein was supplied by the concentrate containing 13.7 per cent protein, there was a considerable increase in milk output up to 21 per cent protein in the supplement. A further experiment was therefore carried out to examine a wider range of protein intakes in

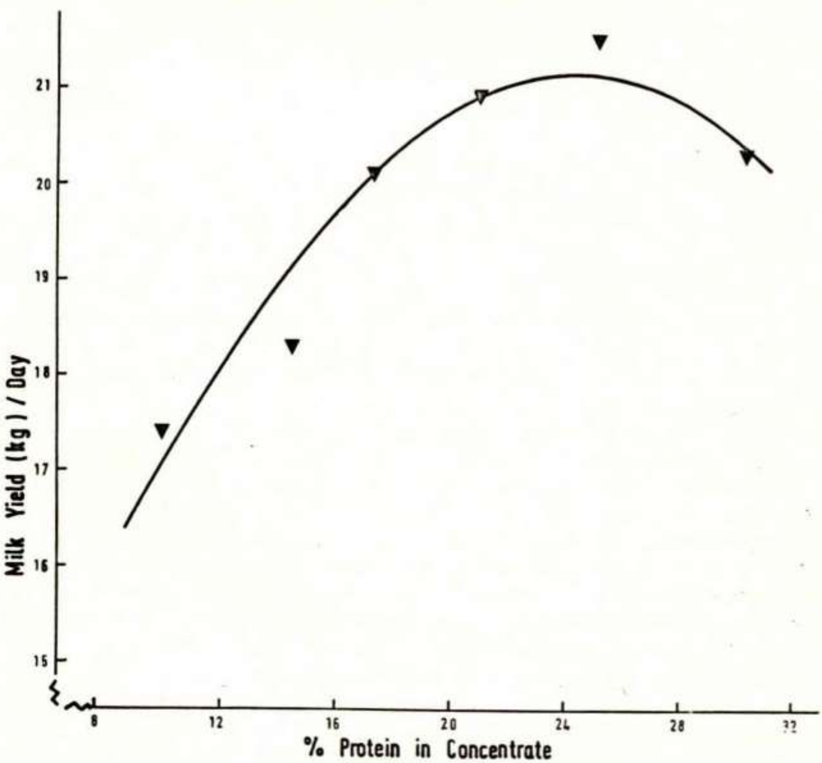
Table 16

Effect of protein content of the concentrate given with grass silage on production

Protein content of concentrate (fresh basis) (%)	9.5	13.7	17.4	20.9
Silage intake (kg DM/d)	6.8	7.5	7.8	7.4
Milk yield (kg/d)	18.0	19.3	20.4	21.7
Liveweight change (kg/d)	−0.2	0.0	0.1	0.0

order to establish at what level of protein in the concentrate the maximum milk yield was obtained. In this trial concentrates with six protein contents ranging from 10 to 29 per cent on a fresh basis were used (24). The effects on milk output are shown in Fig. 2 and the relationship between

The Effect of Protein Content of Concentrate on Milk Yield with a Silage Based Diet



milk yield and the percentage protein in the concentrate can be described by the following relationship:

$$Y = 8.95 + 1.0\,X - 0.0205X^2$$

where Y = milk yield in kg/day and X = percentage protein in the supplement on a fresh weight basis.

Using this relationship it has been calculated that for this particular silage maximum milk yield is achieved by giving a concentrate containing 24.4 per cent protein on a fresh basis. However, economic return is maximised at the point where the cost of an additional unit of protein is offset by the returns in terms of the additional milk produced. At present Northern Ireland prices, a percentage unit increase in protein content increases the cost of the ration by about £1.20 per tonne. With milk at 11p per litre an increase of approximately 0.09 kg milk per day is required to cover this cost and profit is therefore maximised at 22 per cent protein content in the concentrate. Even if the cost of increasing protein content were to double relative to the value of milk, profitability would still be maximised with a concentrate containing around 20 per cent crude protein.

There is, however, one point with regard to the response to protein which as yet has been unexplained. This refers to the fact that while the two previous experiments have shown large responses to protein, a further trial at Hillsborough did not demonstrate this effect. If the information coming from other centres is also examined it also appears that there has been a response in some cases but not in others. The question arises as to why this difference is obtained—is it due to the animals used in these trials or the silages which they have been given?

In an attempt to answer this point a changeover trial has been carried out to determine whether the response to increased protein is affected by wilting prior to ensiling. In this trial a high digestibility grass was ensiled either directly or after wilting to 39 per cent dry matter. Each of these silages was given with supplements containing 13 or 21 per cent crude protein on a fresh basis. The preliminary results from this trial are given in Table 17.

Table 17

The effect of silage type on the response in milk yield obtained from increasing protein in the concentrates

Silage Type	High digestibility unwilted		High digestibility wilted	
Protein content of concentrate (%)	13	21	13	21
Silage intake (kg DM/day)	8.8	9.1	9.7	9.4
Milk yield (kg/d)	23.3	23.9	22.8	25.0
Liveweight (kg)	544	555	552	550

These results showed little response to increased protein when the unwilted material was used yet, when the same material was wilted, a considerable and statistically significant increase in yield was obtained when the protein content of the supplement was increased. The response of 2.2 kg milk obtained with the wilted material is directly in line with the response obtained in our earlier trials.

Conclusion

In conclusion let us now turn our thoughts to some of the areas in which further research is needed. In this I do not want to produce a catalogue of areas requiring further research, but rather to concentrate on what I consider to be the major areas within the three topics that I have discussed.

Firstly the major problem confronting us in the spring-calving system is the conflict between maintaining a high output per animal, in this case a high milk yield, while ensuring that our stocking rates are high enough to efficiently use the grass which we grow. It has been seen that 250 - 500 litres of milk per cow may be lost at high stocking rates, a loss which cannot be tolerated, and an effect which will become more serious as yield per cow increases. It is likely, therefore, that this will be an increasing problem in the dairy industry and I consider that within the next few years this will be a major factor affecting the attitude of the farmer. It is important, therefore, that research workers should consider ways of maximising the use of grass without severely depressing yield per animal. Unless a solution to this problem is found farmers will relax stocking rates and possibly use supplementary feeds in the quest for high milk yields per cow. Both these approaches would be detrimental to the long-term good of the industry.

Secondly, with regards to silage production we are now at the stage where the effects of different types of silages on animal performance have been quantified. However, we seem to have completely forgotten that machinery is required to produce silage and remarkably little information is available on the interaction between the machine and the grass sward. For example, what effect has machinery, including both type and weight of equipment, on the quality of the silage, the losses during ensilage, and subsequent production from the sward? It is now time that the best type of equipment for silage making has been identified by research workers and these requirements met by the engineer, rather than indiscriminately using the equipment produced by manufacturers which very often were designed for conditions completely different to those under which we operate.

Finally our understanding of silage supplementation is still confused with, for example, there being large and unexplained differences in the response to supplementary protein between silages. We must identify why this is so in order that we can provide a more correctly balanced supplement, both in terms of energy and protein, for differing types of silages. We shall not be efficiently using the feed available until this can be achieved.

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A COMPARISON OF RED CLOVER AND GRASS SILAGES FOR BEEF PRODUCTION

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Two experiments have been conducted to compare red clover and grass silages for beef production and to examine the effects of digestibility of red clover silage and the level of concentrate supplementation on animal performance. In the first experiment red clover silages of high and low digestibility (700 and 600 g kg^{-1} respectively) were produced by cutting red clover (var. Hungaropoly) at early and late stages of maturity. These silages and a grass silage (DMD 710 g kg^{-1}) which had been harvested from a perennial ryegrass sward after a growth interval of 7 weeks were offered *ad libitum* to 48 British Friesian steers (initial liveweight 229 kg) for a period of 11 weeks. The silages were unsupplemented. Silage dry matter intake (kg day^{-1}) and animal liveweight gain (kg day^{-1}) for the three silages were 7.75, 0.89, 6.91, 0.69, 5.59, 0.59 for the high digestibility red clover, low digestibility red clover and grass silages respectively.

In the second experiment red clover silage (DMD 625 g kg^{-1}) and grass silage (DMD 755 g kg^{-1}) which had been harvested from a perennial ryegrass sward after a growth interval of 9 weeks were offered unsupplemented or supplemented with 2 kg of fortified barley per head per day to 48 British Friesian steers (initial liveweight 332 kg) for a period of 19 weeks. Silage dry matter intake, animal liveweight gain and carcase gain data for this trial were presented.

INITIAL RESULTS OF A DAIRY HERD SURVEY IN NORTHERN IRELAND

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A stratified random sample of 600 herds (230 cows per herd) was investigated by interview. Returns were received from 515 herds representing 17% of all dairy cows. These returns are being examined for interactions between fertility and those factors which have been considered to influence the results achieved.

There was a significant difference between the calving pattern of heifers (concentrated in October-November) and cows (distributed uniformly from October to March). This difference may be the result of cumulative time lost annually through reduced fertility.

There was widespread use of three breeding policies, i.e. Bull only, A.I. only and A.I. plus bull. Almost equal numbers of cows are mated by A.I. and by Bull. The overall non-return rate was 71%. Herds using bulls for all breeding had the highest non return rate; those with A.I. had the lowest and the dual policy gave an intermediate value. These records resulted in tighter calving patterns in the herds using bulls.

Only 40% of herds achieved a target of 10 cwt. heifers calving at 24 months. Repeat breeding was a problem associated with underweight heifers (< 950 lbs) at calving. Difficult calving and retained placentae were frequently reported as problems but resulted in very few sales. Repeat breeding in cows was a more serious problem in the summer than in the winter and frequently the affected cow was sold.

Fertility was lower on farms using over 300 units nitrogen per acre on silage grass. The data do not show that this was a direct effect.

Emphasis on heat detection was highly variable and was correlated with the breeding policy adopted. There appears to be considerable scope for improvement in this area.

The data collected indicates that a more detailed study into the individual animal's fertility is necessary before detailed interactions can be determined.

A COMPARISON OF CONSTANT RATE AND VARIABLE CONCENTRATE FEEDING FOR DAIRY COWS

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Thirty Friesian spring calving dairy cows were allocated to two experimental treatments :

(1) fed silage *ad libitum* with 7.27 kg (109 kg for the group) of a 16 percent crude protein dairy ration per head per day;

(2) fed silage *ad libitum* and a total concentrate allowance to the group of 109 kg per day but allocated to cows in relation to milk yield.

Cows were assigned to treatment, after a minimum period of three weeks post calving, based on the milk yield of the last week of the preliminary period.

The mean milk yields for this final week were 22 kg (range 16.3-27.1 for treatment 1 and 22.2 (range 16.4-27.6) for 2. The mean lactation number was 6.4 and 6.1 for treatments 1 and 2 respectively. Concentrate feeding levels for treatment 2 were adjusted at weeks 2, 4 and 6 based on milk yields of the two previous weeks. The experimental period lasted 8 weeks. Cows were individually housed and offered silage at 10 percent in excess of daily intake, all refusals being recorded daily. The daily concentrate allowance was fed in two equal feeds. Milk yields were recorded 5 days per week, milk fat and protein determined once weekly and liveweight were recorded once weekly.

There were no significant differences between treatments in milk yield, milk fat or protein percentage. Silage intakes were lower on the variable concentrate group and cows lost more liveweight. Those cows in treatment 2 receiving the greatest amount of concentrates had a much lower intake (1.3% l.wt) than the cows on the lower concentrate levels (1.6% l.wt). The results indicate, in the absence of competition, that variable rate feeding has no advantage over constant rate feeding for cows at the same stage of lactation.

EMBRYO MORTALITY IN THE COW

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Reproductive failure is one of the major factors affecting output in either the beef or dairy cow herds. Although it is generally accepted that fertilization rates following either natural or artificial insemination are normally close to 90%, calving rates to a single insemination are closer to 50%. While most reports demonstrate the existence and extent of this embryonic loss few of them indicate the timing at which it occurs.

Studies were carried out to determine the fertilization and embryo survival rates at various stages after insemination.

Fertilization rate was estimated at 90% following the use of frozen-thawed semen. However the embryo survival rate at Day 42 was 52%. The extent and timing of this embryonic loss was discussed. Advances in this area could contribute significantly to an increased reproductive rate.

INCREASING THE CALVING AND TWINNING RATE IN THE BEEF HERD

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The recent decline in beef numbers will have serious repercussions on beef output over the next few years. Expansion in the dairy herd sufficient to offset this reduction is unlikely, due to levelling off of milk prices. Increasing the number of calves born is now an urgent necessity for the beef industry. Management can play a major role in determining reproductive rate and intensive management will shorten the post partum interval and increase the conception rate.

Over the past few years part of the research programme in cow fertility at Belclare has been devoted to the induction of twinning as one possible means of increasing the national calf crop with particular references to single suckler herds.

Two aspects of twinning are being examined :

1. Twinning by PMSG (mild superovulation)
   The production of a low level of twinning by administration of PMSG at low doses 500-800 i.u. in conjunction with heat synchronization. This has given a twinning rate of 10% and a 15% increase in the conception rate.

2. Twinning by embryo transfer
   This involves the collection of embryos from donor cows and their transfer non-surgically to the contralateral uterine horn of bred recipients. Pregnancy rates of 60% and a twinning rate of 60% of pregnant animals were obtained.

THE EFFECT OF MONENSIN ON THE PERFORMANCE OF STORE LAMBS

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Monensin (Rumensin), used as a feed additive, has been found to improve the feed conversion ratio (FCR) of beef animals on a wide range of diets. This effect is thought to be due to an alteration of fermentation in rumen fluid resulting in increased propionic acid and decreased acetic acid production. In the experiments reported here, the effects of Monensin on the performance of store lambs fattened indoors were studied.

In experiment 1, forty-eight Cheviot ram lambs were fed a whole barley-based concentrate diet containing 0, 15, or 30 ppm Monensin, fed *ad libitum* with or without a supplement of long hay. Monensin at both levels improved live-weight gain and FCR but not significantly so. It significantly increased the proportion of propionic acid in the rumen fluid of the lambs, while it decreased the proportions of acetic and butyric acids. The response to Monensin was significantly greater when hay was supplemented.

In Experiment 2, which was a 2 x 2 x 2 factorial design, forty-eight Cheviot ram lambs were fed a whole barley or a molassed beet pulp-based concentrate diet, containing 0 or 30 ppm Monensin fed *ad libitum*, with or without a supplement of long hay. Feed intake, live-weight gain and FCR were significantly better on the beet pulp than on the barley treatments. However, Monensin did not improve the performance of the lambs and had little effect on rumen fermentation. There was little effect also caused by hay supplementation.

GRAZING BEHAVIOUR OF SHEEP AND CATTLE IN MIXED GRAZING

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A three year experiment showed that mixed grazing increased individual weaned lamb and $1\frac{1}{2}$-year old steer liveweight gains by 10 to 30%. The benefit to either species increased as the proportion in the mix decreased. This experiment attempted to explain the role of complementary grazing with particular reference to sheep grazing 'fouled' herbage (High Grass) around the cattle dung pat areas which cattle refuse.

The results show that on an area basis both cattle and sheep had marked preferences for High as opposed to Low Grass in terms of time spent grazing. The sheep preference was generally twice that of the cattle. On a DM basis cattle grazed High Grass in proportion to the amount of High Grass DM present and sheep preference continued to be about twice that of cattle.

Comparisons at the beginning and end of grazing a paddock showed that both cattle and sheep preferences for High Grass increased significantly with time on both an area and DM bases. The increase was far greater for area (about 206%) than for DM (about 68%). Sheep preference was twice that for cattle at the start and finish of grazing and for an area and DM bases.

Results for four time periods showed that on an DM basis cattle preference for High Grass was significant for the first period only and was less marked as the grazing season advanced. On an area basis cattle had a marked preference for High Grass during all periods. Sheep preference for High Grass was significant during the first and last periods and exceeded cattle preference by a factor of about two on an area or DM basis.

EFFECTS OF EWE PROLIFICACY ON SHEEP INCOME

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The effects of crossing Galway sheep with very prolific breeds on litter size have been reported previously. However, there was a lack of recorded information on the financial consequences arising from the use of new sheep breeds. Consequently, at Blindwell ewe performance and income were compared in two breeds of lowland sheep which differ widely in prolificacy. The two breeds, Galway and Improved Galway, were managed under commercial farm conditions and under the one system of husbandry.

Over the two years 1977 and 1978 the Improved Galway breed produced on average 0.3 more lambs per ewe lambing compared with the Galway. The superiority of the Improved Galway for lamb sales (£) per 100 ewes to the ram amounted to 30% on average over the two years. Gross margin per ewe was improved by over 45% when Improved Galway ewes were used instead of Galway ewes.

It is concluded that large cash benefits are feasible when sheep breeding research results are translated into farm practice.

BREED DIFFERENCES IN THE RELATIONSHIP BETWEEN EWE BODYWEIGHT AND PRODUCTIVITY

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It is well known that there is a positive relationship between ewe liveweight and fecundity (litter size). Since most studies on this topic have used ewes of low to moderate fecundity and future interest will be in more prolific breeds it will be important to know whether bodyweight is more critical with very prolific ewes. Also, if breed differences exist in the bodyweight/fecundity relationship this would imply different cost/benefit functions. The data reported relate to analyses of ewe bodyweight /litter size relationships in Galway, ¼ Finn, Fingalway and High Fertility flocks which are part of the sheep breeding research flocks of The Agricultural Institute. In addition, factors affecting ewe bodyweight have been examined in 15 pedigree Galway flocks over two years. The within flock relationships between ewe bodyweight and litter size and lamb growth rate pre-weaning have also been examined. Bodyweight in all cases refers to weight at the time of mating (October).

The major difference between the genetic groups studied is in fecundity. The average litter sizes (1972-1978) were 1.4, 1.7, 2.0 and 2.0 for Galway, ¼ Finn, Fingalway and High Fertility, respectively. The relationship between bodyweight and litter size was examined graphically for each breed group and 2-tooth ewes were treated separately. For mature ewes the results show a pronounced breed difference with essentially no relationship in the Fingalway and High Fertility groups and a pronounced positive relationship in the Galway and ¼ Finn groups. In the case of 2-tooth ewes all breeds showed a positive relationship at low weights but there was an apparent plateau at higher weights for the two high fecundity breed groups.

The pattern of relationships seen for litter size were also evident for ovulation rate but the volume of data was much smaller.

For pedigree Galway ewes the within-flock regression of litter size on bodyweight (kg) was 0.012 ± 0.003 in the 1974/75 data set and 0.011 ± 0.004 in the 1975/76 data set. The relationship between lamb average daily gain and ewe bodyweight was not significant for the 1974/75 data set (0.0001 ± 0.0004) but was highly significant in the second data set (0.0012 ± 0.0003). Flock differences accounted for approximately 50% of variation in age-adjusted bodyweight. Single-born ewes were heavier than multiple born ewes at all ages; the average difference was 2.8 kg. Ewe bodyweight was also influenced by litter size in the previous spring —ewes which produced singles were heavier at weighing in October than ewes which produced multiples. This effect however depended on ewe age and flock.

Breed differences in the ewe bodyweight/litter size relationship suggest that bodyweight at mating is less critical in highly prolific ewes with consequent savings on inputs at this time which may yield a higher return at around lambing time.

CONTRIBUTIONS TO IMPROVED SOW PRODUCTION

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Rearing more bonhams per sow per year invariably increases profits. Production can commence earlier by mating gilts at puberty rather than at a later oestrus and is likely to produce more pigs per unit time. Puberty can be advanced slightly with various stimuli but does not appear to be retarded by rearing gilts with contemporary boars.

The frequency with which mature boars are used for mating has some effect on litter size.

Re-establishing pregnancy in the weaned sow, especially after the first parity, is an aspect of management where improvements are often possible. The social stimulus of group-housing newly-weaned sows was not beneficial under our conditions. However, exogenous hormone given on the day of weaning to primiparous sows reduced the mean time to conception and increased subsequent litter size. Confirmation of pregnancy has been tested with a commercial ultrasonic device which, together with vaginal biopsy data, suggests that the incidence of pregnancies which are terminated around mid-gestation may warrant further consideration.

A comparison of weaning ages of 10, 25 or 40 days showed that maximum sow production on a herd basis was achieved with 10 day weaning.

It has been suggested that lactating sows have a latent heat three weeks *post partum* and that early-weaning prior to this will result in a shorter time to conception. Our evidence does not support this thesis. Regardless of weaning age the productivity of a sow herd is dominated by first and second parity animals and in particular by the size of their litters.

The number of pigs born per litter should be increased by all possible means since it is now becoming possible to identify the rearing capabilities of the sow and to rear 'surplus' piglets artificially.

EFFECTS OF PHYSICAL FORM OF DIET AND DIETARY LEVEL OF SKIM MILK POWDER ON PERFORMANCE OF PIGS WEANED AT 2-3 WEEKS OF AGE

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A total of 180 pigs weaned within 13-19 days of age, of 4.7 kg mean initial liveweight and penned in groups of 6 were assigned to a 3 x 2 factorial experiment in which three physical forms of starter diet were each followed by two physical forms of grower diet. The forms of starter diet were pellets (4.75 mm diam.), ground meal and flaky meal. The flaky form was created by omitting to grind the flaked maize which was present in the starter diets at a level of 200 g/kg. The forms of grower diet were pellets (4.75 mm diam.) and ground meal. The change from starter to grower occurred at 12.5 kg liveweight with both diets given *ad libitum*. Meal diets gave a higher liveweight gain from weaning to 12.5 kg liveweight but the difference between the meal and pellet forms was small during the 12.5 to 25 kg liveweight stage. Pelleted diets gave superior conversion ratios during both stages. The flaky meal form of the starter diet gave a slightly slower growth rate than the ground meal form from weaning to 12.5 kg liveweight.

In a 4 x 3 x 2 factorial experiment four levels of skim milk powder in the starter diet were combined with three times of changeover to the grower diet and two levels of skim milk powder in the grower diet. The levels of skim milk powder in the starter diets were 0, 100, 200 and 300 g/kg, the changeover times were 7, 14 and 21 days post-weaning and the levels of skim milk powder in the grower diet were 0 and 100 g/kg. All diets were offered *ad libitum*. Ninety-six pigs weaned at 19-22 days of age were allocated to the experiment. The greater the skim milk content of the starter diet the higher the rate of liveweight gain and the lower the feed conversion ratio. With each incremental change of 100 g skim milk powder per kg starter diet daily liveweight gain increased by about 17 g/day and feed conversion ratio improved by 0.03 units. The pigs grew faster when skim milk was included in the grower diet but there was no consistent response to variations in the time when the starter diet was replaced with the grower diet.

FACTORS AFFECTING THE EFFICIENCY OF FEED UTILIZATION IN PIGS

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This experiment was designed to assess the effect of diet form on feed utilization efficiency. The Moorepark standard diet fed in meal form (control), pelleted, or with 2% added fat were compared. Digestibility studies indicated that the meal, pelleted, and 2% fat diets contained 3.035, 3.007 and 3.085 Mcal D.E./kg respectively. The slightly lower digestible energy content of the pellets corresponded with their lower dry matter and suggests that pelleting does not improve the digestibility of diets. The feeding trial involved 576 pigs penned in groups of 16 and housed in a conventional type building which was naturally wentilated, with temperature maintained around 21°C. All pens had a 1.83 meter feed hopper and an *ad libitum* supply of water. Sufficient feed to last a six hour feeding period was allocated each morning. Pigs fed the pelleted and fat supplemented diets had feed utilization efficiencies 5% and 2% respectively better than the meal fed pigs. The improved efficiency on the fat supplemented diet is no more than expected from the digestibility data whereas the pelleted diet performed above expectation. This suggests considerable wastage of feed in the case of the meal and fat supplemented diets. Visable feed wastage was not observed.