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Feeds and Feeding for Efficient Beef Production

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Hay still accounts for a greater proportion of conserved dry matter than silage, although the quantity of silage dry matter conserved has doubled over the last 10 years. Despite improvements in grass utilization and conservation, beef cattle still rely heavily on cereal-based concentrates, particularly during the winter months. It has been estimated that 2.9 m tonnes of concentrates are used annually in beef production systems and

Table 1

Consumption of concentrates by cattle

		Per day (lb)	Total per animal (tonne)	% of ME supplied by concentrates
Dairy calves				
Age at slaughter	24 months	3.5	1.14	42
	18 months	3.5	0.88	50
	15 months	6.2	1.30	70
	11 months	10.2	1.55	100
Suckled calves				
Overwintered		3.0	0.19	44
Fattened		6.3	0.43	60
Store cattle				
Fattened		6.2	0.43	70

this represents some 30% of UK barley grain production (Wilkinson, 1976). Currently, beef systems which fatten animals from the dairy herd for slaughter at about 2 years of age, and those over-wintering suckled calves, rely least on concentrated feeds. In these systems some 40% of energy is supplied by concentrates (Table 1). The high usage of cereals in most cases arises because the herbage is too mature when harvested, and consequently its D value is low. Feeding silage with a low D value has a marked effect on growth rate if the silages are offered alone and on the amount of additional cereals required to achieve target growth rates (Table 2). A silage of moderate quality with a D value of 58 together with 0.75 lb/day barley will support a daily gain of 1.0 lb in a steer weighing 8 cwts, whereas a very good silage will give twice the daily gain if supplemented with 2.75 lb/d of barley.

Table 2

The effect of silage quality on beef production using an animal weighing 8 cwt and eating 16.5 lb dry matter daily

D. value	67	61	58
M.E. concentration (MJ/lb)	4.6	4.2	4.0
M.E. intake (MJ)	76.5	69.7	66.0
Barley required to achieve daily gain of :			
2.2 lb	2.7	3.7	4.3
1.1 lb	Nil	Nil	0.7

Most beef production systems are concerned with converting home-grown feeds into live weight and ultimately carcass meat, and the costs of these feeds must be considered when planning a feeding programme. The yield of dry matter and energy for various feeds together with total costs of production are given in Table 3. The costs were provided by the Farm Management Division of the North of Scotland College of Agriculture (NOSCA) for average crop yields, and include variable costs, equipment and storage costs, interest, rent and general overheads operating in June 1975. A number of the feeds provide considerably more energy per acre than barley grain, and those feeds supplying the highest yields also provide energy at the lowest cost.

Table 3

Yield and cost of energy supplied by various feeds

	Dry matter/ acre (tonne)	ME/acre (MJ)	Yield relative to barley grain	Total cost per acre (£)	Total cost per 10,000 MJ (£)
Hay (2 cwts)	3.2	26880	140	64.8	24.1
Silage (2 cwts), unwilted	3.0	26400	140	85.5	32.4
Straw	1.1	8000	42	64.2 (Straw and Barley)	22.7 (Straw and Barley)
Barley	1.4	19200	100		
Swedes	2.5	32000	167	58.6	18.3
Fodderbeet	3.8	52100	270	58.6	11.2

Supplements with conserved feeds

When conserved forages are used for beef production it is usually the aim to use as much of the forage as possible and to use supplements to make up any deficiencies that are found on analysis of the forage. A shortage of energy may occur through the conservation of mature herbage or herbage cut from late season regrowths. When it is found necessary to offer a supplement, this is usually provided in the form of cereals and the amount of cereals offered has a marked effect on the intake of silage. An experiment was conducted by Dr. Broadbent at NOSCA in which different ratios of grass silage and rolled barley were offered to Friesian steers. Animals offered 20% barley (i.e. 3.5 lb/d) consumed a similar amount of silage to that of animals offered only silage. As the amount of barley offered was increased, the barley substituted for silage and the amount of silage eaten dropped (Table 4). The extent of the substitution increased as the proportion of barley in the feed was increased. In trials

Table 4

Complete diets containing mixtures of silage and barley

	% Silage				
	100	80	60	40	20
Dry matter intake (lb/d)	14.0	17.4	17.7	17.7	16.2
Silage dry matter (lb/d)	14.0	13.9	10.6	7.1	3.2
Replacement value		0	−0.5	−0.7	−0.8
Weight gain (lb/d)	0.9	1.7	2.2	2.1	1.8

conducted at the Rowett Institute the value of chopped swedes or fodderbeet as alternatives to barley have been compared using grass silage made from wilted and unwilted material. When a supplement of 4½ lb swede dry matter was offered it was found that silage intake was lower with unwilted silage containing 18% dry matter than silage made from similar herbage but containing 26% dry matter. This was not found when chopped fodderbeet was used. In these trials the supplement containing 4½ lb swede or fodderbeet dry matter had a similar effect on silage intake depressing it by some 22%. These same supplements have subsequently been compared in a trial with Friesian steers given grass silage containing 20.5% dry matter and D value 65, and grown from 8 cwt to slaughter at 10 cwt. The results are given in Table 5. There were no significant differences in feed intake or rate of gain due to the supplement. Killing-out percentage was lower for animals given swedes or swedes with barley. On the basis of the costs given in Table 3, the cost of supplying the swedes or fodderbeet is likely to be about 65% of that for the supplement of rolled barley.

The green brassicae, such as kale and cabbage, are highly digestible and like the swedes can produce high outputs of feed per unit area. There

Table 5

The value of different supplements to grass silage

	Rolled barley	Chopped beet	Chopped swedes	Swedes + barley
Silage dry matter (lb/d)	12.1	11.0	11.4	12.3
Supplement dry matter (lb/d)	5.7	6.8	5.5	2.8 +2.6
Weight gain (lb/d)	1.9	1.7	1.9	2.0
Killing out (%)	55.8	54.6	53.8	54.5
M.L.C. class	3,2	3,1.6	3,2	3,2

is no information on their value as a replacement for cereals in diets for beef cattle. They do, however, suffer from a disadvantage not apparent with the root brassicae in that they contain goitrogens and high concentrations of a haemolytic constituent which may mean that their intake must be controlled if the animals are not to suffer from anaemia and a period of inappetance. Green brassicae cou'd be used to replace concentrates in feeds for beef cattle particularly when the concentrates are used as a supplement to silage. It could be that using green brassicae wou'd not depress forage digestibility to the same extent as that with a supplement of concentrate (El-Shazly, Dehority and Johnson, 1961).

In most of the experiments in which different supplements have been examined, it has been customary to offer these twice daily with the forage offered to appetite. In this situation it has been argued that at certain times of the day rumen pH may fall below that considered optimum for the most efficient digestion of plant fibre. As a result the intake of forage would be reduced. Experiments have been reported in which the intake and digestibility of feeds offered as a complete diet or separately have been compared. A growth and digestibility trial has been reported by Zea Salgueiro (1975) and an intake and digestibility trial made at the Rowett Institute. In the trial with growing steers, the animals were offered different ratios of barley to grass silage and the barley was offered once daily, twice daily or mixed with the silage. The silage intake of all the animals that were offered their barley twice daily was higher than that of animals offered the complete diet or once daily feeding of barley. Once daily feeding of barley reduced total feed intake to the greatest intake when there were high proportions of barley in the diet. In this trial the live weight gain and organic matter digestibility were not affected by the frequency of feeding the barley. These results are supported by the results of the digestibility trial in which feed intake and the digestibility coefficients for dry matter and crude fibre were similar when dried grass was offered to appetite alone, or with barley given twice daily, or barley was given alone in the morning and dried grass alone at night (Table 6). These experiments would suggest that unless a high proportion of concentrates are being fed once daily there is likely to be no benefit to be gained, in terms of more efficient beef production, from using a complete diet rather than separate feeding of the forages and concentrates.

Table 6

The effect of frequency of feeding 30% barley on total dry matter intake and digestibility

	Dried grass	Dried grass + barley offered 2/d	Dried grass (PM) barley (AM)
Dry matter intake (lb/d)	16.3	17.3	18.5
Dry matter digestibility (%)	79.8	80.1	80.2
Crude fibre digestibility (%)	86.3	83.7	83.0

This view on complete diets is reinforced by recent observations made at the Rowett Institute on animals that were offered silage to appetite and either 4½ or 9 lb rolled barley in two feeds daily. Measurements of rumen pH made before the meal of barley and at hourly intervals thereafter, showed only small declines in pH, the largest being from 7.2 to 6.7 with 9 lb barley. In these experiments the rate of digestion of plant fibre in the rumen was not affected by the amount of barley offered which was not surprising in view of the small decline in rumen pH. It would appear therefore from these observations that variations in rumen pH are not the main cause of the depression in silage that occurs when highly digestible feeds like barley or swedes are offered to beef cattle.

Substitution of cereals by fodder crops

The attraction of using fodder crops in beef production systems is that they are likely to provide cheaper energy than cereals. The greatest impact is likely to be in intensive systems that at the present time rely heavily on cereals. Root crops have been used for a long time as a feed for cattle but they are now a more attractive feed to grow. A number of experiments have been made with sliced swedes and with chopped fodderbeet. A summary of the results of these is given in Tables 7 and 8. In the trials using swedes, daily dry matter intake and rate of gain were lower over the first month of the trial for animals having more than 66% of the dry matter supplied by swedes. As a result, their overall dry matter

Table 7

The replacement of rolled barley by swedes

	Sliced swedes (% of diet dry matter)				
	0	34	50	66	100
Dry matter intake (lb/d)	13.6	14.3	13.8	12.5	13.2
Weight gain (lb/d)	2.3	2.4	2.1	1.9	1.9
Feed conversion (lb DM/lb)	5.9	5.9	6.5	6.6	6.9
Killing out (%)	55.6	55.5	56.1	55.8	55.3

intake and rate of gain were lower than those of animals offered only barley. The lower feed intake over the early part of the trial was not apparent with the fodderbeet and as a result daily gains were better with fodderbeet than with swedes. In these trials animals offered only swedes or fodderbeet consumed about 140 or 85 lb respectively of the feeds daily. Associated with the high intake of swedes was a high urine output and an increased demand for straw bedding. In practice, the intake of root crops could be controlled by the amount of barley offered; for example, steers weighing 6 cwt and offered 6 lb rolled barley would eat about 75 lb swedes and their daily gain should be about 2 lb. Killing-out percentage was not affected by the inclusion of the root crops in the feed and

Table 8

The replacement of a rolled barley-soya bean mixture by fodderbeet

	Chopped beet (% of diet DM)				
	0	34	50	66	100
Dry matter intake (lb/d)	14.3	14.9	15.1	17.6	16.2
Weight gain (lb/d)	2.5	2.3	2.3	2.8	2.1
Food conversion (lb DM/lb)	5.6	6.3	6.5	6.2	7.6
Killing out (%)	56.7	57.6	56.0	57.5	55.8

carcasses from animals given roots were similar to those of animals given only barley. On the basis of the trials made so far the value of swede and fodderbeet dry matter has been about 85% of that of barley dry matter.

When straw is used in diets for fattening beef animals, it is usually considered essential that it should be mechanically processed so that it can be mixed with the concentrates to form a complete diet. A complete diet containing a mixture of concentrates and milled straw is a safe method of feeding a relatively large amount of concentrates daily. Milling the straw, however, does not affect its digestibility but with young animals may increase the amount eaten. In addition to the milling of straw there are now available chemical treatments that increase its D value by 50%. Since the D value of straw can vary from 28 to 40 (Palmer, 1976) careful selection of straw and rejecting straw from those varieties known to have a low D value will be most worthwhile. Typical results achieved using Friesian steers weighing 5 cwt and given complete diets containing a mixture of concentrates and 15 or 30% straw are given in Table 9. Daily live-weight gain and carcass gain declined as the proportion of straw in the diet was increased so that feed conversion was poorer with diets containing straw. In addition, the proportion of "fill" in the alimentary tract increased when straw was included in the feed and this reduced the killing-out percentage. In Table 10 the relative values of diets containing

Table 9

The value of replacing concentrates with ground straw

	Straw (%)		
	0	15	30
Dry matter intake (lb/d)	15.2	17.4	18.7
Live weight gain (lb/d)	2.5	2.2	2.2
Feed conversion (lb/lb LW gain)	6.0	8.0	8.4
Feed conversion (lb/lb carcass gain)	10.4	13.8	15.0

ground straw are given, these being based on differences in feed conversion for animals grown from 5½ to 8¼ cwt. These indicate the relative cost of diets containing different proportions of ground straw so that the cost per unit live-weight gain is similar to that of animals given concentrates alone. Furthermore, it allows an estimate to be made of the cost that could be attributed to the straw. This would include its purchase price, mechanical processing and subsequent mixing of the feed. There

Table 10

The relative costs of diets containing ground straw

	% ground straw					
	0	10	20	30	40	50
Feed conversion (lb/lb gain)	7.4	8.1	8.7	9.4	10.0	10.7
Value relative to concentrates at £80/tonne (£)	80	72.8	68.0	63.2	59.2	55.2
Cost of concentrates (£)	80	72.4	64.0	56.2	48.3	40.4
Costs for straw (£)	—	0.4	4.0	7.0	10.9	14.8
£/tonne	—	4.0	20	23.3	27.2	29.6

would appear to be no justification for including small proportions of ground straw in the feed but with feeds containing 30-50% straw, the straw costs must not exceed £23-30 per ton respectively. Similar calculations based on the use of chopped straw for fattening beef cattle are given in Table 11. From these figures there would seem to be no justification for using chopped straw with a concentrate mixture for fattening beef cattle.

Table 11

The relative costs of diets containing chopped straw

	% chopped straw					
	0	10	20	30	40	50
Feed conversion (lb/lb gain)	7.4	8.1	9.2	10.7	12.3	13.9
Value relative to concentrates at £80/tonne (£)	80	72.8	64.0	55.2	48.0	42.4
Cost of concentrates (£)	80	72.4	64.0	56.2	48.3	40.0
Costs for straw (£)	—	0.4	—	—	—	2.0
£/tonne	—	4.0	—	—	—	4.0

Trials with Friesian cattle grown from 6-9 cwt have been made at the Rowett Institute with barley straw treated with sodium hydroxide to improve its nutritive value (Pirie & Greenhalgh, 1977). Calculations like those for Tables 10 and 11 indicate that barley straw, coarsely milled and treated with sodium hydroxide, and included at between 40-60% in feeds for beef cattle, must cost no more than about £35 per tonne.

There are a number of alternative ways in which the efficiency of a beef enterprise could be improved by increasing the output of live-weight gain from a given area of land and reducing its cost of production. Some of the ideas already discussed, if implemented, could mean radical changes to an existing feeding and cropping programme, and may create problems in the distribution of labour. Many of them involve increases in the amounts of feed that have to be handled and perhaps processed. There are really no generalisations that can be made and final decisions must involve the individual farm when an overall view can be taken to decide whether any changes are really worth while.

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Optimum Beef Output from Silage

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Introduction

For many years, conserved forage for beef cattle was only expected to supply maintenance—live-weight gain being obtained from the inclusion of large quantities of cereal and protein in the diet. Quality of forage for the beef animal was of a low priority, quantity being the major consideration. In contrast, greater emphasis has been placed on the quality of forage for the dairy cow than for the beef animal.

This being the case, what is the potential of high quality silage for the beef animal ? Should the aim be to realise the potential of high quality grass silage ? If the answer is 'yes', the question of how to produce high quality silage immediately arises. If the silage is high quality, is supplement required and, if so, how much ? The conflict between quality and quantity must also be resolved. If the silage is of high quality will stock numbers have to be reduced ?

Animal production from silage

The potential of grazed grass for promoting high live-weight gains in beef animals is well recognised. In most instances, however, grass silage has a much lower potential for producing live-weight gain and is often only capable of providing maintenance. Methods of improving the rate of gain from grass silage have been investigated at Hillsborough. This paper reports results from experiments on silage quality and the results have been used to calculate beef output per acre to enable conclusions to be drawn on the optimum output of beef from silage.

Several factors influence animal production (either live-weight gain or milk yield) from grass silage and these include stage of growth of grass at harvest, fermentation quality and the dry matter content of silage. Of these, perhaps the major factor affecting the level of animal performance is the stage of growth at which grass is cut. If high quality material is not harvested, then the opportunities for improving animal performance from silage by manipulation of the other factors are virtually non-existent. Silage can never be better than the grass from which it is made.

At Hillsborough, the effect of stage of growth of grass at ensiling on animal production has been examined in two experiments. Stage of growth was determined, primarily by cutting date, and subsequently by the interval between cuts. In the first experiment the intervals were 5½, 7 and 9 weeks and harvesting began on 11th May, 21st May and 4th June respectively. In the second experiment, which was designed to investigate the performance of animals offered high, medium or low quality silage with different levels of barley, the regrowth intervals were 6, 9 and 12 weeks with harvesting commencing on 14th May, 4th June and 25th June respectively.

In both experiments grass from 20 acres of an S24 perennial ryegrass/ S100 white clover sward, sown in 1967, was used. The sward was closed for silage in January and fertilizer in the form of a 2:1:1 compound was applied at the end of March. In the first experiment a total of 300 units N, 150 units P_2O_5 and 150 units K_2O were applied per acre during the season, applications being split equally between cuts with each regrowth interval (i.e. for a 9 week interval giving 3 cuts over the season, 100 units N, 50 units P and 50 units K were applied per acre for each cut). In the second experiment fertilizer was applied at the rate of 1.6 units N per acre per day for the duration of the regrowth interval, up to a maximum of 100 units.

Harvesting took place throughout the growing season and grass yield was recorded. The grass was direct cut using a flail forage harvester and formic acid was applied as an additive at the rate of ¾ gallon/ton of fresh grass.

Experiment 1

The mean yield of grass cut at 5½, 7 and 9 week intervals is given in Table 1.

Table 1

Yield of grass cut at 5½, 7 and 9 week intervals (tons/acre) (mean for 1973, 1974)

Interval	Fresh yield	Dry matter yield
5½ weeks	33.1	5.4
7 weeks	37.9	6.2
9 weeks	38.5	6.1

Grass yield for the 5½ week interval was slightly lower than that for either the 7 or 9 week intervals.

As indicated by pH, the silages were all well preserved. There were only slight differences in the dry matter contents of the silages. Crude protein content decreased and crude fibre content increased as the interval between cuts increased.

The chemical composition of the silages is presented in Table 2.

In 1973, the silages were offered *ad lib.* to 84 Hereford cross suckled calves (mean initial liveweight 5.6 cwt) either with or without 4.4 lb barley. However, animals at this stage are still growing and it was decided that the barley treatment be replaced with more mature animals. Thus, in 1974, 42 Hereford-cross, suckled calves (mean initial liveweight 4.7 cwt) and 42 Hereford-cross stores (mean initial liveweight 7 cwt) were offered the silages, with no barley.

Table 2

Chemical composition of silages (%)

Interval	Dry matter	Crude protein	Crude fibre	pH
5½ week	19.6	16.7	33.1	3.7
7 week	19.6	15.7	34.6	3.7
9 week	18.8	15.2	36.7	3.7

Table 3

Silage dry matter intake (lb/day) of suckled calves and stores

Interval	Suckled calves			Stores
	No barley 1973	No barley 1974	4.4 lb barley 1973	No barley 1974
5½ weeks	10.2	10.4	9.9	14.3
7 weeks	10.0	10.0	9.7	14.7
9 weeks	10.8	9.8	10.1	13.1

The silage dry matter intakes are presented in Table 3.

The dry matter intake (DMI) of silage by suckled calves offered no barley was similar for all types of silage. When barley was offered, silage DMI was slightly reduced. The silage DMI of store cattle was higher than that for suckled calves and there was a tendency for intake to increase as the interval between cuts was reduced.

The animals were weighed twice weekly and the daily live-weight gains are presented in Table 4.

Table 4

Daily live-weight gains (lb/day) of suckled calves and stores

Interval	Suckled calves			Stores
	No barley 1973	No barley 1974	4.4 lb barley 1973	No barley 1974
5½ weeks	1.3	1.7	2.3	1.8
7 weeks	1.1	1.6	2.3	1.8
9 weeks	1.0	1.1	2.0	1.3

In both 1973 and 1974, the live-weight gain of suckled calves on silage alone increased due to early and more frequent cutting. Supplementation with barley increased live-weight gain, the effect being less marked with high quality, 5½ week silage.

The live-weight gain of store cattle increased as the interval between cuts decreased from 9 weeks to 7 weeks. The daily gains from 5½ and 7 week silage were identical.

After approximately 15 weeks on silage alone, 24 store animals were slaughtered. Carcase weights and kill-out percentages are presented in Table 5.

Table 5

Carcase weight and kill-out of store cattle offered silage

Interval	Carcase weight (lb)	Kill-out (%)
5½ week	534	55.6
7 week	531	55.2
9 week	487	54.3

Carcase weight was higher for 5½ week than for 9 week silage and percentage kill-out was also higher.

In terms of feed conversion (Table 6) the results show that with high quality silage less feed is required per pound of live-weight gain than with poor quality silage. Supplementation also reduced the feed requirement per pound LWG, the reduction being greatest with low quality silage.

Table 6

Feed conversion ratio (lb/DM/lb LWG)

Interval	Suckled calves			Stores
	No barley 1973	No barley 1974	4.4 lb barley 1973	No barley 1974
5½ weeks	8.3	6.1	6.3	8.0
7 weeks	9.0	6.3	6.0	8.2
9 weeks	10.2	8.9	7.0	9.8

Experiment 2

The mean yield of grass cut at 6, 9 and 12 week intervals is presented in Table 7.

Grass yield was highest for grass harvested every 9 weeks. The yield of grass harvested at 12 week intervals was lower than that for the 6 and 9 week intervals.

The chemical composition of the silages is given in Table 8.

Table 7

Yield of grass cut at 6, 9 and 12 week intervals (tons/acre) (mean for 1975, 1976)

Interval	Fresh yield	Dry matter yield
6 weeks	28.9	5.0
9 weeks	33.7	6.0
12 weeks	22.2	4.2

Table 8

Chemical composition of silages (%)

Interval	Dry matter	Crude protein	Crude fibre	pH
6 week	20.0	15.2	33.6	3.8
9 week	21.6	14.5	34.9	3.7
12 week	22.2	12.6	37.6	3.8

As indicated by pH, the silages were well preserved. The silage dry matter and crude fibre contents increased and crude protein content decreased as the interval between cuts increased.

The silages were offered *ad lib.* with either 0, 2.2 or 4.4 lb/day of barley to Hereford-cross suckled calves (mean initial liveweight 6.1 cwt) and silage dry matter intakes are presented in Table 9.

Table 9

Silage dry matter intakes (lb/day) of suckled calves

	Level of barley (lb/day)		
	0	2.2	4.4
6 weeks	13.9	11.9	11.4
9 weeks	12.1	11.4	12.2
12 weeks	12.8	13.0	12.2

The DMI of silage was lower for 9 and 12 week silage than that for 6 week silage. The DMI of silage was reduced by supplementation, the reduction being greater for 6 week silage than for 9 and 12 week silage.

The animals were weighed twice weekly and daily gains are presented in Table 10.

Table 10

Daily live-weight gain of suckled calves (lb/day)

	Level of barley (lb/day)		
	0	2.2	4.4
6 weeks	1.1	1.5	2.0
9 weeks	0.7	1.2	1.6
12 weeks	0.3	1.1	1.5

As in Experiment 1, liveweight gain increased as a result of earlier and more frequent cutting. Supplementation increased daily gains, the effect being more marked in the case of the low quality, 12 week silage.

The feed conversion ratio is presented in Table 11.

Table 11

Feed conversion ratio (lb DM/lb LWG)

	Level of barley (lb/day)		
	0	2.2	4.4
6 weeks	12.0	10.2	8.0
9 weeks	17.3	11.4	9.4
12 weeks	46.7	12.4	10.3

The feed requirement per pound of gain was lower for high quality, 6 week silage than for low quality, 12 week silage. As in Experiment 1, supplementation reduced feed conversion ratio, the effect being most marked for 12 week silage.

Silage digestibility

It is well known that the digestibility of silage declines as grass matures, the rate of decline being highest in the latter half of May and the first half of June. The effect of earlier and more frequent cutting on silage digestibility can be seen in the results given in Table 12.

The extent of the relationship between silage digestibility and liveweight gain is obvious from research work in An Foras Taluntais (Table 13).

It is clear, therefore, that earlier and more frequent cutting increased the digestibility of silage and as a consequence, daily liveweight gain, carcase gain and feed conversion ratio of beef catt'e were improved. Supplementation with barley increased daily gain and reduced feed conversion ratio.

Table 12

Dry matter digestibility (%) of silage cut at different intervals

	Interval	Dry matter digestibility	
		1973	1974
Experiment 1			
	5½ weeks	72.9	70.8
	7 weeks	71.1	70.1
	9 weeks	67.5	62.4
Experiment 2		1975	
	6 weeks	69.1	
	9 weeks	66.5	
	12 weeks	64.4	

Table 13

Relationship between silage digestibility and live-weight gain (mean for 42 silages)

Mean dry matter digestibility	61	66	70
Mean LWG (lb/day)	0.6	1.0	1.6
		(Flynn, 1976)	

Red clover silage

Recently there has been a renewed interest in the us of red clover for silage. The increasing cost of fertilizer nitrogen, coupled with the development of new disease resistant, tetraploid varieties, capable of producing high yields of forage with a high protein content has stimulated this interest. Research work has shown that high levels of animal performance can be achieved from red clover silage. However, red clover has several disadvantages. The crop is difficult to establish and due to its erect type of growth is more suited to silage than to grazing. Due to the low dry matter content and the high protein - low sugar content the crop is difficult to ensile successfully. The use of the crop is restricted to beef animals since red clover contains oestrogenic compounds which are likely to reduce fertility of breeding animals. Experiments in Scotland (Frame, Harkness and Hunt, 1976) have shown that the DM yield of red clover is normally slightly lower than that expected from good grass swards receiving high levels of nitrogen. Dry matter yield and crude protein content is presented in Table 14.

At Hillsborough, the feeding value of red clover silage has been investigated. Red clover (variety Hungaropoly) was ensiled in September. The crop was wilted or 24 h and formic acid was applied as an additive at the rate of ¾ gallon/ton. The red clover silage was compared with

Table 14

Yield and crude protein content of red clover

	Cut number			
Date	1 21 June	2 9 August	3 4 October	Total
Dry matter yield (t/ac)	3.1	1.5	0.1	4.7
Crude protein content (%)	15.8	18.1	20.6	—

grass silage made from the second cut of an S24 perennial ryegrass sward ensiled in July, 9 weeks after the previous cut. 'Sylade' was applied as an additive to the grass silage at the rate of ½ gal/ton. The chemical composition and dry matter digestibility of the silages are given in Table 15. The grass silage was of low quality as indicated by the low dry matter digestibility.

Table 15

Chemical composition and dry matter digestibility of silages

	Red clover silage	Grass silage
Dry matter content (%)	19.7	25.6
Crude protein	21.3	16.1
pH	4.0	4.3
Dry matter digesitibility	66.9	61.2

The silages were offered *ad libitum* to 36 British Friesian steers (mean initial live-weight 6 cwt). The silage dry matter intake and daily live-weight gain of the animals were recorded and the results are presented in Table 16.

Table 16

Silage dry matter intake, live-weight gain and feed conversion of steers

	Red silage	Grass silage	Grass silage + barley (5.5 lb/day)
Silage dry matter intake (lb/day)	16.2	14.4	12.3
Live-weight gain (lb/day)	2.3	1.1	2.0
Feed conversion (lb DM/lb LWG)	7.0	13.1	8.5

The DMI of red clover silage was higher than that from grass silage. Supplementation of grass silage reduced silage intake. Daily live-weight gain was highest from red clover silage and lowest from grass silage offered alone.

Conclusions

Finally, to enable an optimum level of beef output from silage to be determined, the results have been related to production on a per acre basis. In such an exercise, certain assumptions must be made. The yield of edible silage may be calculated from grass DM yields if a 20% dry matter loss from the silo is assumed. An average yield of barley of 35 cwt/acre has also been assumed.

From the results, the output of beef per acre from each system can be calculated, bearing in mind that 'per acre' takes into account the acreage required to produce any barley offered to the cattle. The potential beef production from the various systems is presented in Table 17.

Table 17

Potential beef production per acre from silage or silage + barley (cwt/ac)

Interval	Suckled calves No barley	Suckled calves 4.4 lb barley	Stores
Experiment 1			
5½ weeks	13.4	9.6	10.0
7 weeks	13.0	10.2	12.2
9 weeks	10.5	8.8	9.7
Experiment 2	Level of barley (lb/day)		
	0	2.2	4.4
6 weeks	6.3	7.2	7.4
9 weeks	5.6	6.7	6.6
12 weeks	1.6	4.4	4.9

In Experiment 1, the highest LWG per acre was produced from silage cut at 5½ week intervals and offered to suckled calves. In other words, for the smaller animals, 5½ week silage with no barley was the most efficient system on a per acre basis resulting in the maximum beef output per acre. For store animals, the maximum output of beef was obtained from 7 week silage. In practical terms, however, optimum output from either suckled calves or store animals would probably be from silage cut at 7 week intervals. Although LWG was almost doubled when barley was offered, the extra acreage required to prcduce the barley, reduced the output of beef per acre to a level which was well below the optimum. However, in order to finish a 5-6 cwt suckled calf indoors during the winter, a level of output which is below the optimum may have to be accepted.

In Experiment 2, the maximum output of beef per acre was obtained from silage cut at 6 week intervals. Supplementation with barley increased the total output per acre, the effect being most marked with low quality silage.

The actual outputs from the two experiments do not appear to correspond, but the trends in output per acre resulting from earlier and more frequent cutting are identical.

The output of beef from red clover silage can also be calculated and the results are presented in Table 18.

Table 18

Potential beef output from grass and red clover silages

Ration	Beef output (cwt/ac)
Red clover silage	10.8
Grass silage	6.1
Grass silage + 5.5 lb barley	6.5

Silage made from red clover produced a greater output of beef per acre than grass silage or grass silage and barley.

In conclusion, successful winter fattening depends on three factors: purchase price, sale returns and feed costs. Beef farmers make great efforts to ensure that the lowest purchase and the highest selling prices are obtained. Feed costs, however, are often ignored. In U.K., Meat and Livestock Commission recordings (1976) on beef fattening units have shown that the most efficient units have lower feed costs/lb of gain, mainly due to higher rates of gain and less dependence on expensive purchased concentrate. The production of high quality silage, combined with a reduction in the quantity of concentrate in the ration to produce the optimum beef output per acre, can reduce feed costs per lb of gain.

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Feeding Supplements with Silage to Fattening Cattle

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The economics of feeding supplements with silage to fattening cattle is of immediate interest and this paper is concerned with, firstly, how much barley should be fed and, secondly, the role of alternative crops such as fodder beets.

Where fattening cattle are fed conserved grass over the winter period, the major factors determining the level of concentrate supplement are :

1. The extra weight produced from concentrate feeding.
2. The extra cattle carried as a result of concentrate feeding.
3. The autumn/spring cattle price change.
4. The price of concentrates.

The data presented here are the average results obtained from 18 experiments at Grange in which cattle were fed grass silage alone or with different levels of supplementary barley. The levels of barley fed varied from 3 to 10 lb per animal daily and from these the responses from feeding 4 or 8 lb per day were calculated.

Extra weight produced from barley feeding

The average daily liveweight gain of animals fed silage alone or with 4 or 8 lb barley daily were 1.25, 1.83 and 2.09 lb respectively. A daily liveweight gain of 1.25 lb when fed silage only demonstrates that moderate to high quality silages were used in these studies. When calculated over a 140-day feeding period, animals fed silage plus 4 and 8 lb barley daily gained 80 and 117 lb more liveweight than those fed silage only (Table 1).

The corresponding figures for extra carcass were 51 and 79 lb. Therefore 10.9 and 14.1 lb of barley were required to produce 1 lb of extra

Table 1

Effect of feeding barley with silage on 140-day gains

	Barley fed (lb/day)		
	0	4	8
Liveweight gain (lb)	175	255	292
Carcass wt. gain (lb)	90	141	169

carcass when 4 and 8 lb were fed respectively. A good response was obtained from feeding the first 4 lb barley but increasing the level of supplementation from 4 to 8 lb daily only increased carcass gain by 28 lb over a 140-day feeding period or 20 lb barley was required per lb of extra carcass (Table 2).

Table 2

Responses from barley feeding (lb barley per lb gain)

	1st 4 lb barley (0 to 4)	2nd 4 lb barley (4 to 8)
Liveweight	7.0	15.1
Carcass weight	10.9	20.0

Effect of barley feeding on silage intakes

Feed ing 4 lb barley daily depressed intakes of silage by 10 per cent (Table 3). When 8 lb of barley was fed daily, silage intakes were depressed by 18.5 per cent.

Table 3

Effects of feeding barley with silage on silage intakes

	Barley fed (lb per day)		
	0	4	8
Silage DM intake (lb/head daily)	16.0	14.4	13.1
Relative silage intakes	100.0	90.0	81.5

Financial returns from barley feeding

From these results, the financial returns were calculated for a farm situation involving a winter feeding period of 140 days where 300 tonnes silage (17.0 per cent dry matter) is available. The number of cattle which can be carried for 140 days is 50, 56 and 61 where 0, 4 and 8 lb barley is fed respectively. The average initial liveweight of the animals used in in the above studies was 884 lb and following a 140-day feeding period, the final liveweights (mart weight) are 1031, 1111 and 1148 lb for those fed 0, 4 and 8 lb barley respectively (Table 4). The corresponding figures for carcass weights are 535, 586 and 614 lb.

In order to place the returns to barley feeding in their proper perspective, the returns from feeding silage alone are shown in Table 5. The extra returns obtained from feeding 4 and 8 lb of barley daily with silage are shown in Table 6.

Table 4

Animal production data on feeding barley with silage (300 tonnes) to fattening cattle

	Barley fed (lb/day)		
	0	4	8
No of animals carried for 140 days	50	56	61
Final liveweight - mart (lb)	1031	1111	1149
Final cold carcass weight (lb)	535	586	614

Table 5

Returns (£) from feeding silage alone (300 tonnes)

	Purchase price (£/cwt)	
Selling price (£/cwt)	28	31
28	−1590	−2834
31	− 185	−1429
34	1220	− 24
37	2625	1381

Returns = Net margin (labour not included in costs) less interest on working capital
Silage = £5.00 per tonne
Accommodation = £75 per animal

Table 6

Extra returns (£) from feeding barley with silage (300 tonnes)

	Barley fed (lb/head daily)	
Winter price increase (£/cwt)[1]	4	8
0	296	−50
3	599	527
6	902	1104

[1]Purchase price £28 per cwt

As used in Table 5 return is taken to mean 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. The extra returns from meal feeding (Table 6) is the difference between the returns 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.

The following points arise from Table 5 and 6.

1. When silage only was fed, a winter cattle price increase of about £3 per cwt was necessary to break even when all costs were charged with the exception of labour. The price increase required to break even would be greater at lower levels of production.
2. Having covered costs, a further £3 per cwt cattle price increase improves the returns from feeding the 300 tonnes silage (produce of 20 acres cut twice) by £1,405 when silage alone is fed. Therefore, the price increase of cattle per cwt over the winter is the major factor determining returns from winter feeding.
3. The average killing-out percentages were 50.5, 51.4 and 52.2 for those fed 0, 4 and 8 lb barley respectively. Therefore, the economic returns from barley feeding are higher where the animals are sold in carcass form rather than live at a similar price per cwt. Thus, in calculating the extra returns from barley feeding allowance is made for the higher killing-out percentage of the barley fed groups.
4. When rolled barley is charged at £85 per tonne, feeding 4 lb barley daily with silage improved returns in all circumstances.
5. Examination of the extra returns from feeding barley with silage shows that where there is no increase in the price per cwt for beef over the winter period the economic level of barley feeding is 4 lb daily. However, with a price increase of £6 per cwt in winter feeding 8 lb barley gives better returns than feeding 4 lb daily.
6. As the sale price increases relative to the purchase price, the economics of meal feeding improve.

Effect of barley price on returns

In the above calculations, rolled barley was charged at £85 per tonne. The effect of increasing the cost of barley by £10 or £20 per tonne on the extra returns from feeding barley with silage (300 tonnes) is shown in Table 7. Increasing the cost of barley by £10 per tonne reduces returns by £141 and £313 when 4 and 8 lb are fed daily respectively. Thus the cost of barley becomes increasingly important as the level of barley feeding increases.

Variations in responses to supplements

In the above experiments, large variations were obtained in responses to similar levels of barley feeding. While it is generally accepted that better responses can be expected with poor rather than good quality

Table 7

Effects of barley price on extra returns[1] from feeding barley with silage (300 tonnes)

	Barley fed lb/day	
Barley (£ per tonne)	4	8
85	902	1104
95	761	791
105	620	478

[1]Purchase price £28 per cwt; sale price £34 per cwt

silages, this was not very clear-cut from the above experiments. However, one consistent finding was that a good response in animal performance was always obtained when the effect of supplementation on silage was small. Likewise, when the depression in silage intake at a particular level of barley feeding was large, a poor animal response was obtained from the supplement. As increased carrying capacity is such an important factor in the economics of feeding supplements, the general belief that a higher barley feeding level can be used to overcome the disadvantages of poor quality silage is not true.

Pelleted dried grass as a supplement to silage

In two experiments, pelleted dried grass was compared with barley as a supplement to grass silage. In each experiment, the silage was well preserved (pH 3.9) and of high dry matter digestibility (69 per cent). The pelleted dried grass was also of high quality (dry matter digestibility of 75.5% and 75.0% in Experiments 1 and 2 respectively). The feeding periods lasted for 98 and 112 days in Experiments 1 and 2 respectively during which silage was fed to appetite. The treatments were (1) no supplement, (2) 3.3 lb dried grass, (3) 6.6 lb dried grass, (4) 9.9 lb dried grass, (5) 3.3 lb barley and (6) 6.6 lb barley per animal daily. The combined results for the two experiments are presented in Table 8. At each level of supplementation, liveweight and carcass weight gain for animals fed dried grass and barley were similar. Feeding 3.3, 6.6 and 9.9 lb of supplement decreased daily silage intakes by 12, 18 and 24 per cent respectively but there was no difference between the two supplements. On the basis of these experiments, it appears that dried grass as a supplement to silage can be substituted for barley on the basis of digestible organic matter. However, because of the high crude protein content of dried grass compared to barley, it is most useful in diets where additional protein is required.

Fodder beet roots as a supplement to silage

High dry matter yields per acre make monogerm continental varieties of fodder beet attractive as a winter feed for cattle. In four experiments,

Table 8

Weight gains of cattle fed dried grass and barley supplements with silage (lb/105 days)

	Supplements (lb/day)					
	None	Dried grass			Barley	
	0	3.3	6.6	9.9	3.3	6.6
Liveweight	144	188	201	196	180	205
Carcass weight	85	121	131	133	119	131

pulped fodder beet roots (variety Monorosa) were evaluated as a supplement to grass silage for fattening cattle. The chemical composition of the fodder beet roots and silages used are given in Tables 9 and 10. The fodder beet roots had a dry matter content of approximately 20 per cent, were of high digestibility (DMD = 86%) but tended to be low in crude protein (approximately 7%). In general, clay contamination amounted to approximately 5 per cent as indicated by the silica content. The silages used were in general of high digestibility and were properly preserved.

Table 9

Composition of fodder beet roots

Experiment	Dry matter (%)	DMD (%)	Crude protein (%)	Silica (%)
1	15.1	84.6	11.5	4.5
2	21.2	87.9	6.6	5.0
3	19.5	85.5	7.8	5.4
4	20.8	85.1	7.7	7.1

Table 10

Composition of silages

Experiment	Dry matter (%)	DMD (%)	Total crude protein (%)	pH
1	18.4	67.0	12.8	4.2
2	21.1	69.2	11.0	3.7
3 (A)	23.8	61.4	16.4	4.7
(B)	23.2	72.7	13.0	4.0
4	24.2	72.7	13.1	3.9

In Table 11, a summary of the results is shown and the feeding periods ranged from 122 to 142 days. Daily liveweight gains of animals fed silage alone was 1.0 lb in Experiments 1, 2 and 4 and 1.8 in Experiment 3. In Experiments 1, 2 and 3, 5.5 lb of supplementary barley was fed daily per animal and in Experiment 4, 11.0 lb barley was given. A similar quantity of supplementary dry matter was fed to other treatment groups either as fodder beet alone or as fodder beet/soyobean meal. The

Table 11

Extra carcass gain of cattle fed barley, fodder beet and fodder beet/soyabean

Feeding period (days)	Daily livewt. gain (lb) silage only	Daily supplement lb barley equivalent	Extra carcass gain (lb) from feeding		
			Barley	Fodder beet	Fodder beet/ soyabean
122	1.0	5.5	48	30	—
132	1.0	5.5	58	25	65
122	1.8	5.5	9	11	17
142	1.0	11.0	117	—	94

amount of soyabean meal fed daily per animal varied from 0.75 lb (Expt. 2) to 1.5 lb (Expt. 4). The results show that with the exception of Experiment 3, the extra carcass produced from supplementation was lower when fodder roots alone were fed than when barley was fed. However, inclusion of soyabean with the fodder beet gave responses quite similar to that obtained from barley. In Experiment 3, animal performance on silage alone was excellent and the responses to all supplements was poor with no difference between supplements. The figures for feed intakes (Table 12) show that the depression in silage intakes from similar quantities of supplementary fodder beet and barley were the same.

In conclusion, fodder beet roots can be a satisfactory alternative to cereals as a supplement to silage for fattening cattle. Because of the low protein content of the roots, additional protein may be required particularly when the silage is low in protein or roots form a high proportion of the total diet. This can be overcome however, by ensuring that the grass for silage is cut at a leafy stage when protein content is higher and by using other supplements of high protein content such as high quality dried grass.

Future of fodder beet as a winter feed

Hay or silage have been regarded as our main and, in many cases, our only source of winter feed for cattle. Because of the high proportion of land devoted to permanent pastures, conserved grass will continue to be our major winter feed source. While dry matter production per acre from

Table 12

Dry matter intakes (lb per animal daily)

Experiment		Supplement fed with silage			
		None	Barley	Fodder beet	Fodder beet/ soyabean
1.	Silage	18.5	16.1	15.9	—
	Supplement	—	4.4	4.8	—
	Total	18.5	20.5	20.7	—
2.	Silage	18.0	15.5	14.4	14.6
	Supplement	—	4.2	4.8	4.7
	Total	18.0	19.7	19.2	19.3
3.	Silage	20.2	16.2	15.6	15.7
	Supplement	—	4.6	4.6	4.6
	Total	20.2	20.8	20.2	20.3
4.	Silage	13.0	9.6	—	9.7
	Supplement	—	8.6	—	8.8
	Total	13.0	18.2	—	18.5

grass is good, this in itself is not sufficient for the future. In most situations, the limiting factor is land, and beef producers will have to think more in terms of beef production per acre rather than just feed dry matter production. However, when fodder beet, barley and grass silage are considered in the context of production per acre, the high yields of good quality material obtained from fodder beet makes it attractive as a winter feed. Dry matter yields of fodder beet (variety Monrosa) obtained in four Institute centres in recent years show that about five tonnes of roots and two tonnes of tops per acre can be expected. Useable yields of dry matter and metabolizable energy per acre are higher for fodder beet compared with barley and grass silage (Table 13). The calculations shown

Table 13

Useable yields per acre of fodder beet, barley and grass silage

		Tonnes DM	ME (1000 MJ)
Fodder beet	— Roots	4.5	66
	— Tops	1.0	
Barley	— Grain	1.7	29
	— Straw	1.0	
Grass silage		4.0	40

ME = Metabolizable energy

in Table 14 demonstrate that the higher yield of fodder beet per acre offsets higher production costs compared with barley and grass silage, resulting in small differences between the three crops in production costs per unit of feed energy. Because of the low proportion of tillage in the country the scope for fodder beet as a major source of feed is limited. However, it merits very serious consideration as part of the rotation on cattle/tillage farms.

Table 14

Production costs for fodder beet, barley and grass silage

Crop	Production costs (£/ac)	Costs per tonne DM(£)	Costs per 1000 MJ ME (£)
Fodder — Roots			
beet — Tops	150	27	2.3
Barley — Grain			
— Straw	55	32[1]	1.9
Grass silage	90	23	2.3

[1] = grain only; ME = Metabolizable energy

The Performance of Beef Crosses from the Daird Herd

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The Irish cattle population has a different structure to that of other European countries: firstly, the proportion of beef to dairy cows is greater, and secondly, the extent to which beef bulls are used on dairy cows is higher than elsewhere in Europe[1]. Approximately one-third of the national cow herd are single sucklers and it is estimated that of the dairy cows in the country, 64% are Friesian or Friesian type. It is likely that the change from a mainly Shorthorn national herd of some years ago to an almost complete Friesian herd will be complete in another few years. It is necessary to breed over 50% of the dairy cows back to Friesian in order to provide sufficient replacements[2]. Disease eradication schemes could result in even more replacements being required. Friesian steers (and/or bulls) and culled cows (particularly with the trend towards high feeding levels) will therefore remain important sources of beef. If we use higher levels of feeding than heretofore, we can expect that Friesian male progeny are likely to be increasingly acceptable in Europe.

Dairy cows which are not required for breeding replacements and the cows of the national suckler herd are therefore available for beef crossing.

The greatest opportunity for using beef bulls occurs in the single suckling herd. Systems of single suckling have been described[3]. It is now accepted that decreasing the level of nutrition immediately before calving eases any calving problems that might occur. While such reduced nutrition is acceptable in the suckler cow herd, it is not acceptable with dairy cows. Consequently, the ease of calving problem is greater in dairy than in beef herds.

What breed of bull, therefore, are we likely to cross on that portion of the dairy herd which is not needed to produce replacements? Results on the performance of cross breds at Grange are presented in this paper. It is realized that in dairying, calving difficulties can over-ride any advantage in performance due to choice of bull. Aspects of calving difficulties have been discussed previously[4].

Liveweight performance

The liveweight performances of the various breeds and crosses compared at Grange are shown in Table 1, with particular emphasis on the performance of the progeny of the continental breeds.

There is considerable variation between these experiments. More O'Ferrall and Cunningham[1] combined the results on a relative basis, together with R. Fallon's data at Grange, and these are presented in Table 2.

Table 1

Average liveweight performance (kg) of different breeds and crosses

Expt. No.	Breeds						Age (days)
	Fr.	H x Fr.	Ch. x	AA x Sh.	Simm.	H x Sh.	
1	469.6	—	—	439.0	—	474.7	740
2	409.9	—	—	—	—	393.3	595
3	399.5	—	—	376.4	—	392.3	588
4	—	483.6	498.2	—	—	488.1	600
5	551.0	—	546.0	—	—	—	720
6	—	—	522.0	—	515.0	—	720
7	—	318.0	312.0	—	—	—	330
8	486.4	464.9	514.0	—	496.1	—	600
9	455.5	451.1	453.6	—	462.3	—	500

Table 2

Comparison of growth rate for different breeds and crosses on a relative basis

Relative daily gain (kg)					
Fr.	H x Fr.	H x Sh.	Ch. x	Simm. x	AA x Sh.
100	100	98	107	103	94

The approximate 7% advantage in growth rate in favour of Charolais crosses is now accepted and if animals are killed at higher weights in the future, the advantage in favour of the continental breeds is likely to increase.

Results on the effects of rearing animals as bulls are summarised in Table 3, for the breeds now available.

These results are the means of experiments at Grange and should not be taken as comparisons between breeds and crosses. They merely show the effects of non-castration on liveweight performance. In all breeds there is considerable extra gain to be obtained by non-castration. Also, greater liveweight gain can be obtained by non-castration than by changing breed.

Dressing-out percentages

Dressing-out is really only important when the returns are compared to what might have been paid for the animal alive. But as long as there is an alternative live trade, the relationship between dressing-out percentage and the liveweight is obviously important. If there is no live trade, as is more or less the case in pigs, then dressing-out percentage is of less

Table 3

Average final liveweights (kg) and percentage difference between bulls and steers slaughtered at 2 years of age

	Bulls	Steers	% growth rate in favour of bulls
Friesian	562	514	10.1
* Ch. x	605	546	11.2
** Simmental	558	515	9.0
*** H x Sh.	471	441	8.13

Collins, D. P. and Harte, F. J. (5)
* Charolais crosses on Shorthorn and Friesian
** 20 animals only
*** Slaughtered at 19 months of age

interest to the producer. Then, factors such as lean meat production and efficiency of feed conversion become more important. Dressing-out percentage is very important for factory buyers because they buy most of their stock live. There, the relationship between the live prices is important, as is of course the yield of carcass from a factory efficiency point of view.

When animals are killed at a constant degree of finish, and this is not always easy to determine, differences between breeds and crosses in dressing-out percentages are small, with a tendency for the beef breeds to dress-out better[1]. Average dressing percentages of 'finished' breeds and crosses are given in Table 4.

Table 4

Average dressing-out percentages of different breeds and crosses—all considered to be 'finished' at slaughter

	Fr.	H x Sh.	AA x Sh.
Wt. at slaughter (kg)	537.7	498.1	450.1
Age at slaughter	723	695	659
Dressing-out percentage	57.7	57.3	57.9

Harte, F. J. and Conniffe, D. (6)

However, when animals were slaughtered on an age basis, rather than on degree of finish, the faster growing animals (unless they are on a very high plane of nutrition) had on average the lowest dressing-out percentage. This is shown in Table 5.

The figures in Tables 4 and 5 should only be considered relative to each other. The final slaughter weight was taken at the slaughter house

Table 5

Average dressing-out percentage of cattle slaughtered at a constant age when Friesians were not 'finished'

	Fr.	H x Sh.	AA x Sh.
Wt. at slaughter (kg)	472.4	476.1	442.4
Age at slaughter	737	737	737
Dressing-out percentage	56.6	58.8	58.6

Harte, F. J. and Conniffe, D. (6)

immediately before slaughter (not the "farm" weight) hence the high dressing-out percentages. They also include the kidney and channel fat in the weight of carcass. These fats are now removed at the slaughter house before the carcass is weighed and this has the effect of reducing dressing-out percentages by about 1½ percentage units. (Kidney and channel fat weights vary considerably and can range from 2 to 5% of the hot carcass weights).

Table 6 gives average dressing-out percentages of Friesian and Charolais bulls and steers. It is interesting to note that the Friesian bulls and Charolais steers which were almost the same weight at slaughter, had similar dressing-out percentages.

Table 6

Average dressing-out percentage of Charolais crosses and Friesians

	Friesian		Charolais x	
	Bulls	Steers	Bulis	Steers
Dressing-out percentage	54.3	52.4	56.2	54.2
Wt at slaughter	551	551	605	546

Collins, D. P. and Harte, F. J. (7)

The animals were slaughtered at two years of age. These are based on "farm" weights but the kidney and channel fat is included. It is well known that dressing-out percentage increases with weight and particularly with degree of finish. Consequently, bulls can be expected to dress-out better than comparably fed steers simply because they are heavier at slaughter.

Carcass composition

Carcasses consist of three components—bone, fat and lean meat. The latter is the valuable component. The average price of lean at the factory is 24 times the price of bone and six times the price of fat. Thus, the amount of lean in the carcass is the important criterion. Breeds, and in particular the stage at which they are slaughtered, influence carcass composition. Experiments at Grange have shown that there are large differences of lean and fat in the different breeds. Results are given in Table 7.

Table 7

Average hot carcass weights (kg) and lean, fat and bone as percentages of carcass weight

	Fr.	H x Sh.	AA x Sh.
Hot carcass weight (kg)	309.7	283.8	260.5
Lean %	71.1	65.8	67.0
Fat %	15.3	22.8	21.0
Bone %	13.6	11.5	11.9

Harte, F. J. and Conniffe, D. (6)

The animals were slaughtered when they were considered to be 'finished' and the lean meat is defined as everything other than fat and bone. The figures should therefore be considered relative to each other.

The average composition of Friesian, Charolais and Simmental crosses is given inTable 8. The method of carcass dissections reported in Table 8 was similar to that carried out at the factory. The carcass weights however cannot be directly compared because the results are from two different experiments.

Table 8

Average hot carcass weights and lean, fat and bone as percentages of carcass weight

	Fr.	Ch. x	Simm. x
Carcass weight (kg)	289	296	285
Lean %	64.1	68.7	67.6
Fat %	18.6	14.4	16.5
Bone %	16.3	16.8	15.5
Lean to bone	3.93	4.08	4.36

Collins, D. P. and Harte, F. J. (5, 7)

The effect of leaving the animal entire on carcass composition is shown in Table 9.

It is clear that the effect of non-castration decreases fat content and increases lean content very considerably. The effects of non-castration have been presented to this Association previously and published[8, 9].

Table 9

Average carcass composition of Friesian and Charolais cross bulls and steers

	Friesian		Charolais	
	Bulls	Steers	Bulls	Steers
Lean %	71.8	64.1	74.3	67.2
Fat %	10.7	18.6	10.4	17.0
Bone %	15.7	16.3	15.3	15.8

Collins, D. P. and Harte, F. J. (5, 7)

For increased growth rate, growth promoters have also shown potential[10] towards efficiency in beef production.

On the question of carcass shape, no significant relationship between yield of high priced cuts and shape have been observed. However, there is likely to be a relationship between shape (or conformation) and lean to bone ratio in the carcass.

The ability of the continental crosses to produce lean meat is extremely important. Because of the faster growth rate and leaner carcasses at heavier weights, the extra yield of lean can be very significant. This is clear from Table 10, where the yield of lean meat is expressed in absolute terms. In these calculations the following assumptions are made:

1. A Friesian carcass weight of 280 kg — readily achievable from a Friesian steer out of the two year old beef system[11].
2. The Charolais steer is 7% heavier than the Friesian steer.
3. Leaving the animals as bulls increases weights by 10%.
4. From various experiments, on average a Friesian steer carcass contains 66% lean and a Charolais cross steer 68%.
5. Friesian and Charolais cross bull carcasses contain on average 71 and 74% lean respectively.
6. A price of 150p/kg of lean meat (approx. 68p/lb).

Summary

The emphasis is likely to be on lean meat in the future—as meat becomes more expensive fat cannot be afforded because it is too expensive to produce on the animal and it is too expensive to sell at a low price. As the processing industry hopefully develops, fat will be unacceuptable at the factory. The data in Table 10 emphasize the ability of the continental breeds compared to the traditional beef breeds to produce lean meat. It is likely that cattle will be killed at heavier weights in the future (as is at present the case in France) in order to spread high calf prices over bigger carcasses and also because of high killing and processing costs. Thus, there will be future emphasis on the use of continental beef crosses. The calving problem is, however, impeding the greater use of these larger breeds on the dairy herd. Finally, experimental results at Grange have been derived

Table 10

Carcass weights and estimated yield of meat and returns from Friesian and Charolais crosses either as bulls or steers

Breed	Carcass weight (kg)	Lean meat % in carcass	Absolute yield of lean meat	Returns @ 150p/kg
Friesian (steer)	280	66	185	£277
Charolais (steer)	300	68	204	£306
Friesian (bull)	308	71	219	£328
Charolais (bull)	330	74	244	£366

mainly from Charolais crosses. This does not mean that other fast growing breeds are not as good.

Acknowledgments

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A System for the Production of Two Year Old Beef and its Role in the Development of the Beef Production Industry

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Introduction

The Irish cattle production industry is based on a large number of small production units. Table 1 shows that in December 1975 the average herd size was 27 cattle (of all classes). The national beef cow herd accounts for at least 30% of total cows and consequently is responsible for 30% of total beef production. It too is based on small herds, the average being six beef cows. Table 1 shows that 50% of the total cattle population in December 1975 was wintered in herds containing fewer than 46 cattle (all classes), and this proportion is spread over 84% of farm holdings having cattle. Likewise 85% of the holdings having beef cows were responsible for 50% of the beef cow population in herds of nine or fewer cows. (Our dairy industry is also based on small units; average dairy cow herd size is 10 cows, with 50% of all dairy cows in herds of 22 or less).

Thus the farms on which at least half of the animals which provide our beef industry are very small units. This fact has important implications for the short term expansion and development of the industry.

Table 1

Structure of cattle production industry. December 1975 (Source : CSO, Dublin)

	Beef cows	Total cattle	Dairy cows
Average herd size	6	27	10
Median herd size	9	46	22
% farmers with herd $\leq$ median	85	84	86

The cattle production industry contains considerable division of labour and considerable trading in cattle at production stages intermediate between calf and beef. The industry is dominated by calf to weanling or store systems, weanling to store, and store to beef systems with very few farms specialising in integrated calf to beef systems. This extensive approach to beef production is reflected in the age structure of the national cattle herd. Eighty per cent of the annual male calf crop survives in the herd as animals between two and three years old and 17% of the crop survives to over three years old. These figures illustrate the very considerable potential which exists for the application of more intensive feeding systems.

Despite the division of labour between different sections of the industry there is remarkably little real specialisation except on the farms producing beef in Winter/Spring/early Summer from Autumn/Winter purchased stores. Costs in this system are high but it is based chiefly on the expectation that the Spring/Autumn price per kg for beef will be considerably higher than the Autumn per kg purchase price. It appears that this is the only sector of the present cattle industry which has made a major fixed capital commitment to beef production.

This system cannot profitably be expanded indefinitely.

Gross margins in beef systems at Ballinalack

Systems which have attracted capital investment in cattle have been determined by the fact that financial rewards from cattle production do not always accrue to efficiency in cattle production. This may be illustrated by figures from two farm units operated by the Agricultural Institute at Ballinalack, Co. Westmeath. Output from these systems is shown in Table 2.

One of the units was a store to beef system producing beef from animals purchased at 400 - 450 kg stores in Autumn and sold as stores or beef in April/June. The other was a weanling to beef system producing two year old beef in Spring from weanlings purchased in October-November.

Table 2

Beef output and gross margins on two cattle systems, Ballinalack 1972-75

	Weanling to 2 year old beef	April-June Stores to stores or beef
L.wt. gain kg/acre	356	216
Gross margin £/acre	65.6	90.3
Contribution of price change between buying and selling to gross margin £/acre	+3.0	+49.2

The store to beef system always yielded a higher gross margin than the two-year-old system despite the fact that liveweight gain per acre was always considerably higher for the latter. Such systems have attracted most of the capital invested in çattle production and this investment has been based on expected seasonal price changes. The contribution of the seasonal price change to gross margin in the Ballinalack store to beef system averaged £49.2 (or +54.5% of total) for years 1972-75. The high replacement cost of weanlings in the weanling to beef system in the same years resulted in the trading element of that system increasing the gross margin by £3.0 per acre (Table 2). However, in three out of four years the trading element in this system reduced gross margin by an average £16 per acre (or −34.5% of total in these years).

Constraints on Winter beef system

Recent increases in the general cattle price level, combined with the currently very high interest rates, pose serious problems for anybody *now* commencing to develop an intensive Winter/Spring beef system. The high peak borrowing for stock in itself poses a problem which is seriously aggravated by working capital interest charges of up to £20 per animal and housing loan repalyments of £15 per animal. In an intensive Winter beef system these two charges alone can total over £100 per acre. Considering the current cost of feeding as well as fixed and interest charges it is now difficult to make a modest margin in a newly established intensive wintering system with less than a £12-£14 per 100 kg differential between Autumn store price and Spring beef price. The increased volume of wintering accommodation provided in the last few years and its consequent effect on demand for stores in the Autumn, combined with the forecast decline in the supply of stores in the next two to three years, will make such seasonal price fluctuations highly unlikely in the next few years. It must be borne in mind also that the seasonality in prime cattle slaughterings, although marked (Table 3), is such that the pushing forward of 30,000 prime cattle from the fourth quarter to the first and second quarters would alleviate seasonal variation.

Table 3

Seasonal pattern of prime cattle slaughtering at export factories, 1975-76

Quarter	% of annual prime kill
January - March	23.9
April - June	20.9
July - September	26.3
October - December	28.9

Taking into account the age structure of the national herd already referred to, the feasibility of achieving such a shift in seasonality of slaughtering becomes obvious. This shift in turn, unless countered by a seasonal change in intervention price, will reduce further the likelihood of a sufficient margin to encourage new investment in intensive wintering of cattle for the foreseeable future.

In farm planning the availability of reasonable estimates of input costs and product value is very important. Recent wide fluctuations in calf prices and in store cattle prices make it practically impossible to plan a system suitable for a cattle farm being developed on borrowed money and which yields a stable income from buying calves, weanlings, light stores and selling weanlings or stores. These fluctuations combined with the above constraints on intensive wintering, when examined from the point of view of planned beef production, dictate that all new investment in cattle production be directed into establishing integral production enterprises. These enterprises are based on the rearing and fattening of calves (or occasionally weanlings) to the beef stage on the one farm. This approach to beef production is already well established in all other eight countries in the E.E.C. If our beef production industry is to be developed and expanded to meet the opportunities offered by European markets, it must proceed along these lines.

Two Year Old Beef System

A system for producing beef at two years of age from dairy herd calves has a major role to play in transforming a structured but disorganised industry into a planned, integrated and efficient industry. The system has been practiced on farm units at Grange and Ballinalack by Dr. A. Conway, Dr. J. Harte and Dr. D. Collins. It is also practiced by Dr. P. Caffrey on the University College, Dublin farm at Celbridge. This approach to beef production is now being implemented on a number of commercial farms by the Advisory Service and is being actively encouraged by the chief lending institutions (Associated Banks and A.C.C.).

At Grange, 545 kg Friesian cross steers yielding 293 kg carcases have been produced in the years 1971 to 1974. Initially, the system involved weanlings purchased in November. This weanling to beef system operated at a stocking rate which produced 1¼ finished animals per acre. The The weanling to beef system has been operated also at Ballinalack for four years at the same stocking rate as in Grange. Average production figures for the two locations are shown in Table 4.

Animal performance at Grange has been such that very acceptable beef and good carcase weights have been produced at 24-25 months of age. At Ballinalack performance has not been wholly satisfactory due to excessively high stocking rate in relation to the output of the sward. Average daily gain at grass has been 0.14 kg per day below the corresponding Grange figure of 0.82 kg per day. This reduction accounts for 28 kg liveweight gain or 14 kg of carcase and it arises from excessive stocking density of three yearlings per acre from April to mid August, in relation to pasture production. Grass was usually scarce in the system from the end of the second grazing cycle (early June) onwards resulting in a daily gain from turn-out to mid August of only 0.82 kg compared with the target figure of at least 0.9 kg per day). Another manifestation of the high stocking rate has been the early sale date forced by an inadequate supply of silage. For every one day added to the second winter feeding period, final carcase weight would be increased by about

Table 4

Performance in weanling to two year old beef system at $1\frac{1}{4}$ animals per acre in Grange (1971-74) and Ballinalack (1972-75)—average results (kg)

	Grange	Ballinalack
Weanling wt. November	213	222
Yearling wt. April	289	291
$1\frac{1}{2}$ y.o. wt. November	455	428
Final wt.	545	509
Carcase wt.	293	268
Daily liveweight gain		
1st winter	0.50	0.45
At grass	0.82	0.68
2nd winter	0.73	0.68
Date out to grass	22 April	17 April
Yarding date	15 Nov.	4 Nov.
Sale date	20 March	18 Feb.

0.5 kg. Hence, there is opportunity to improve the Ballinalack carcase weight by at least 15 kg. These two effects of reducing the stocking rate will raise carcase weight to the Grange figure for Friesians of 293 kg carcase.

The calf to beef system is now being operated at Ballinalack at a stocking rate which will produce one finished animal per 1.1 acres of grass. The first batch of calves bought into the system have achieved the target growth rate and are being finished presently.

The conclusion from the Ballinalack trial is simply that each developing farm should build up gradually from present stocking rate towards a stocking rate giving an output of one finished animal per acre per year but the optimum stocking rate appropriate to each farm must be carefully recognised. This is most important in a developing farm situation.

Table 5

Minimum growth rates and weight-for-age targets to make 545 kg beef at 2 years old

Period	Growth rate kg/day	Weight at age	
First summer	0.62	190 kg	8 months
First winter	0.53	270 kg	13 months
Second summer	0.83	445 kg	20 months
Second winter	0.83	545 kg	24 months

The minimum production targets for the system are set out in Table 5. While 295 kg carcase at two year old must be regarded as the target carcase weight for the system, it may be a little ambitious in the first one to two years operation of the system. For this reason we set 281 kg carcase as a readily attainable budgetary target in commercial practice, using Friesian cross calves from the dairy herd. These are minimum target weights which are easily achieved and are readily surpassed where grass management practice and animal husbandry are good.

The winter production targets of 0.53 and 0.83 kg per day for weanlings and finishers respectively compare with 0.1 - 0.3 kg per day on many store cattle farms at present. This difference in winter performance and the grassland management practices on which it is based (i.e. the production of sufficient high quality silage) is the key to the achievement of targets set out for the two-year-old beef system.

The feed inputs and current feed costs are shown in Table 6. In terms of volume, grass and conserved grass are the major feed inputs. The calf will be fed 25 kg milk replacer and 75 kg calf pencils in the period from purchase until two weeks after turn-out to grass. Towards the end of the first grazing season the calf requires 1-1½ kg rolled barley per day in September/October and when grass is scarce. Likewise, 2 kg barley per day may be fed to the 1½ year old cattle under similar circumstances.

Table 6

Feed inputs and feed costs in two-year-old beef system (1976 values)

Feeds	Unit cost	Cost
25 kg milk replacer	£440/tonne	£11.00
75 kg calf pencils	£120/tonne	£ 9.00
525 kg barley	£ 90/tonne	£48.00
8.5 t. silage	£5.50/tonne	£47.00
Grazing		£15.00
Total Feed Cost per Animal		£130.00

In Table 6 allowance is made for feeding ⅔ kg barley per day during the weanlings first winter. If silage is derived from a six week's old growth of grass and if quality is good, barley is not required. The costings also allow for feeding 2¼ kg barley per day to the finishing cattle in the second winter. With good quality silage this will produce 0.8 - 0.9 kg liveweight per day.

The grass management programme for the system involves rotational grazing where possible with the calves grazing ahead of the yearlings, thereby ensuring high quality material. For every animal unit in the system 0.6 acres should be closed in spring for silage to be cut about 20th May. A second cut should be taken from 0.4 - 0.6 acres (depending on grass supply) about 30th June. If required a third cut should be taken off 0.3 acres about 12th August. Minimum silage production must be 8½ tonnes (at 20% d.m.) per animal unit (weanling and finisher) in the enterprise.

Phosphate, potash and lime inputs are indicated by soil tests. Seventy five kg of CAN per acre is applied to the grazing area for early grass. One hundred and fifty kg CAN per acre is used for first and second cuts of silage, and 100 kg per acre is used for the third cut. Seventy five kg are used for the first grazing after silage. These inputs may be reduced depending on the efficiency with which slurry is recycled on each farm.

The calves are given first preference on the silage aftermath. They are worm dosed before being transferred to it. Slurry may be disposed of mainly on the silage area in January (to relieve pressure on storage space later on), after first and second silage cuts and at the end of the grazing season.

The total budgeted feed cost of £130 per animal (Table 6) allows for full recommended inputs of purchased fertiliser and allows full current market price for concentrate inputs. With these inputs an output target of one finished animal per 1 - 1.1 acres good grassland is the eventual objective.

Non-feed costs include rent and rates—£4, mortality—£5, interest on working capital—£30, veterinary/medicine—£4, transport—£3, miscellaneous—£10, and slatted floor housing at current cost (after grant) using long term borrowed money (£20), (assuming some storage sheds and basic equipment already existing on farm). These amount to £76 to give a total production cost of £206.

The predicted price for beef is 121p per kg carcase, grossing £340 per animal. If it is replaced with a calf costing £50, gross output will be £290, and net return to land and labour will be £84 per animal (at present money value). Every 1p increase in realised beef price above 121p per kg will increase the margin by £2.80. More importantly, any increase in calf price above £50 will reduce income by an equivalent amount. Ideally, average calf price should be closely related to the value of 50 kg of finished beef. It is in the beef producers own interest to bear this in mind at all times.

Savings in the costs outlined will be possible. Many farmers will be able to achieve some saving in interest on working capital. Those with partly paid off buildings will save part of the housing cost. Those in a position to purchase and store barley off the combine can save a net £5 per animal. Farms with facilities for the efficient collection and disposal of slurry can save a net £5 - £10 per animal on purchased fertiliser costed in Table 6. Achievement of Grange carcase weight of 293 kg will raise budgeted income by £14. These savings add up to £10 - £67 per animal, making a net return to land and labour of £94 - £151 per animal, depending on farm circumstances and technical achievement.

If there is difficulty in achieving the weanling target weight the following factors should be closely examined :

1. Excessive disease due to bad calf rearing accommodation.
2. Calf made dependent on grass too early in life.

3. Poor grass management.
4. Inadequate treatment for worms and/or hoose.
5. Grass scarcity in autumn.

Failure to achieve winter performance targets will normally be due to one or more of the following :

1. Insufficient winter feed and/or low quality winter feed.
2. Defective yard management.
3. Wet/dirty accommodation.

Normally there will be no difficulty with performance during the second summer at grass except in cases where the stocking rate is high in relation to the output of the sward.

An integrated beef system such as the two-year-old beef system outlined here is appropriate to (1) store cattle producers who require higher and more stable incomes from cattle; (2) farmers embarking on a beef farm development project and making a major capital commitment with borrowed money.

Conclusion

The main advantages of the integrated system approach to beef production are :

1. A basis is provided for the planned development of, and investment in, the beef production industry.
2. It relates financial rewards for beef production to technical efficiency.
3. It permits stable and reasonable income per animal.
4. There is commitment in providing sufficient high quality winter feed for dry stock.
5. It eliminates the store periods in the beef animal's growth and reduces slaughter age with consequent higher quality and greater uniformity in the meat.
6. It saves unnecessary transport and marketing charges.
7. A framework for exploiting lean breeds and bulls for beef production is provided.

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Meeting Factory Requirements for Beef Cattle

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In meeting factory requirements, feeders and store producers can only supply the types and breeds of cattle that are initially available from the dairy herd and single suckling herd. The availability of cattle from these sources is shown in Fig. 1, from data produced by Prof. E. P. Cunningham, The Agricultural Institute, Dunsinea.

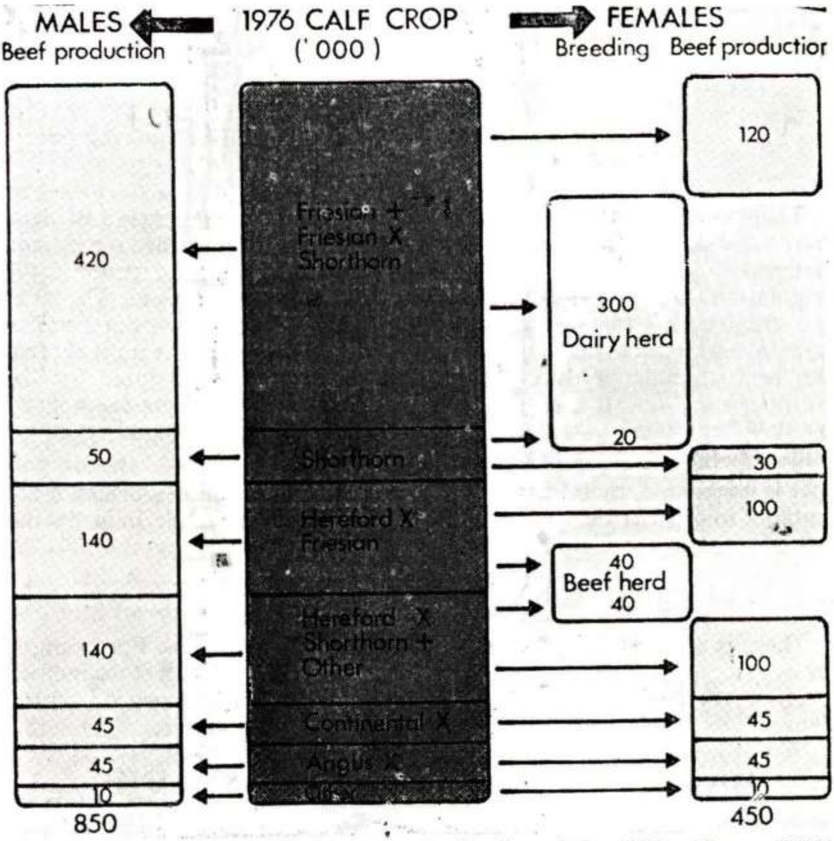

Fig. 1. Approximate composition and destination of the 1976 calf crop ('000)

* Present address: Armer Salmon Agricultural Machinery (a Division of the Irish Sugar Co. Ltd., Carlow)

Calf supplies

The number of cattle in any one year is normally 85% of the cow population, the remainder being accounted for by barren cows, stillborn calves due to Brucellosis and calf mortality. It is therefore estimated that 1.7 million calves were produced from about two million cows in 1976. These calves have since entered the beef production pipeline which will take them through a number of farms and farming systems before reaching slaughter weight in 1978.

Fig. 1 shows that 400,000 calves are required as herd replacements. The remainder, 1.3 million calves, will be reared as prime beef cattle. Of these, 65% are males (845,000) and 35% females. The 1.3 million calves for prime beef consist of the following breeds :

Friesian Friesian x Shorthorn	40%
Hereford crosses	40%
Shorthorns	6%
Angus + Continental crosses	7%
Other breeds	7%

There are only about 100,000 Continental crosses and many of these were sold as calves to Europe. Most of the female calves are reared and fattened for home consumption. Thus, about 50% of the prime cattle population is Friesian and 50% consists of British breed crosses. The latter are suitable only for the British trade. It is well known that our Friesian cows are generally small by Continental standards and it is unlikely that the beef animals produced from these cows will be suitable for the European market. It must be pointed out however that there is emphasis by the Department of Agriculture on maintaining beef quality in the bulls standing at the A.I. stations.

It is concluded, therefore, that the greatest proportion of our cattle are suitable for the British trade only. By and large our cattle industry has not adapted to the Continental market.

Financial considerations in winter fattening

There is a strong risk element in winter fattening systems. For example let us assume a target of 280 lb liveweight gain (LWG) for a store bullock weighing 8½ cwt and fed silage plus barley over a winter period of 160 days. Thus initial costs are :

Store bullock @ £30/cwt delivered	£255
Silage @ £6/ton @ 20% D.M. = £30/ton	1.36p/lb D.M.
Barley @ £80/ton, rolled at 10% moisture	3.63p/lb D.M.

The animal performance target is an average daily gain (ADG) of 1.75 lb. Let us assume that the silage provides for animal maintenance + 1 lb ADG and that 0.75 lb ADG is obtained from 8 lb barley supplement.

Feed costs are :		
Silage	16 lb D.M. @ 1.36p x 160 days	£34.82
Barley	8 lb @ 3.63p x 160 days	46.46
Total cost		£81.28
Total silage	5.80 tons @ 20% D.M.	
Total barley	0.58 tons @ 10% Moisture	

However, if silage is capable of producing 1.35 lb ADG and 0.4 lb ADG is obtained from 4 lb barley supplement giving a total of 1.75 lb ADG, feed costs are reduced :

		£
Silage	20 lb D.M. @ 1.36p x 160 days	43.52
Barley	4 lb @ 3.63p x 160 days	23.29
Total cost		66.81
Total silage		7.25 tons
Total barley		0.29 tons

In these two examples, the total costs (£) and break-even selling prices after 160 days are as follows :

	1	2
Feed	81.28	66.81
Interest @ 15%	17.00	17.00
Housing	5.00	5.00
Labour	5.00	5.00
	108.28	93.81
Purchase price	255.00	255.00
Total	363.28	348.81
Cost/cwt gain	43.31	37.52
Break-even selling price/cwt	33.02	31.71
Killing out at	61 lb/cwt=671 lb	60 lb/cwt=660 lb
Break-even price/lb	54.14p	52.85p
Profit/animal @ 55p/lb	£5.77	£14.19
Profit/100 animals	£577	£1,419

For a range of selling prices, profits and investment/100 animals expressed in £ for the two examples are as follows :

	1		2	
Price/lb	Per animal	100 animals	Per animal	100 animals
54p	−0.93	−93.00	8.91	891
55p	5.77	577	15.51	1551
56p	12.48	1248	22.11	2211
57p	19.19	1919	28.76	2876
58p	25.90	2590	35.36	3536
Investment				
Silage		3480		4350
Barley		4640		2320
Cattle		25500		25500
		33,620		32,170

Thus, it is concluded that :

1. For an investment of about £33,000 in 100 cattle for six months the return at best at 58p/lb is only 11%.

2. The profitability of feeding cattle depends on the cost of the weight gain. Silage quality is therefore of the utmost importance. There can be little doubt that if winter feeding of cattle is to remain profitable both quality and yields of silage must be improved.

Integration of the cattle industry

There is a risk element in cattle feeding with three main economic factors involved :

(a) Purchase price of store cattle.

(b) Cost and quality of feed.

(c) Price of finished cattle.

The feeder has control over only one of these factors, namely, cost of feeding. Although this cost can be reduced, the other two factors have a major influence. In future, feeders will be reluctant to invest money at high risk unless there is a minimum price guarantee before store cattle are purchased. If there is a price guarantee and feed costs are known, feeders will be much more discriminating in the purchase of store cattle. Only the efficient feeders will feed store cattle.

It is much more desirable for the store producer to finish cattle himself and realise the added value. Alternatively the feeder may buy cattle at an earlier stage when investment is much lower. This is common practice in Europe and the U.S.

Variation in animal performance

A major problem in supplying factory requirements is the wide variation in the performance of store cattle in winter fattening systems. Variation ranges from a single suckled fast growing animal to a fairly aged animal which has experienced more than one store period and has possibly been fed on several farms. There is also breed variation. Angus and Herefords mature at relatively low weights, whilst Continental breeds mature at much higher weights.

The feeder must purchase from what is available on the market. Since cattle are not sold individually and are not of known origin, bought-in cattle are generally variable. Different breeds respond differently to any one diet. Despite care in selecting animals for finishing, they have different finishing dates. Some animals become over-fat while others are not sufficiently finished.

At the Irish Agricultural Development Co. Ltd., Castlebellingham, average weight gains for different days on feed were :

Days	No. of animals	L.W.G. (lb)
121-125	68	220
126-130	77	230
131-135	139	226
136-140	158	228
141-145	194	227
146-150	149	223
151-155	133	233
156-160	190	230
161-165	111	239
166-170	77	240
171-175	58	237
176-180	49	260
181-185	29	246
Mean		246

These figures show that it is difficult to meet factory requirements for a standard product.

Competition from the export trade

Live cattle exports in 1975 numbered 695,000. The majority were store cattle destined for the U.K. These are always of high quality, drawn from the top 50% of store cattle presented for sale here. British buyers pay higher prices because of subsidy arrangements. Therefore, the selection of stores available to Irish feeders is restricted in quality. This again leads to less than top animal performance in our winter fattening systems.

EEC price negotiations

These negotiations are usually held in mid-March and the intervention price for top beef is not known until April. Several disadvantages arise from the timing of this announcement :

1. Because of the cost and limited supply of winter feed, feeders delay purchase of cattle until late Autumn, they then compete with each other and store cattle prices rise.

2. Supplies to the factories are delayed in Spring while feeders await the price rise.

3. Store producers are obliged to hold cattle until late Autumn because of the low demand in August and September.

More ordered marketing of cattle, both by store producers and feeders, would emerge if the Spring price for beef could be announced earlier. A price rise in January would promote the supply of cattle to factories in the early part of the year. Cattle would be placed on finishing diets much earlier, before they lose weight on grass in late Autumn. The buying season for stores would be lengthened. Feeders would have less over-fat cattle by not waiting for a price rise. If an increase of 4-5p is expected, there is a substantial effect on the supply of cattle. Moreover, feeders who would sell cattle in January could replace.

Payment for quality

One reason why feeders cannot compete with U.K. and Continental buyers is the absence of any premium on the finished animal when sold to the factory. This does not encourage feeders to purchase the best animals. In fact, many feeders set a fixed purchase price which they will not exceed, and cattle quality is sacrificed. There is therefore little incentive to breed better animals. Factories argue that every farmer has a mixture of cattle and that he will not accept a price differential. Because of M.C.A. arrangements and variation in the price offered for different cuts, factories must frequently change markets depending on price. It is therefore difficult to establish the standards for which a premium should be paid. Despite this it is well known that animals with better conformation are worth more money, because of the higher carcass yields when boned out.

Meeting factory requirements has been discussed only from the winter feeders' point of view. Similar problems arise with cattle finished on grass.

Conclusion

To achieve the best prices on the Continental market, Continental bulls must be used on all breeding animals except for replacement stock and increases in the dairy herd.

There must be improved standards of feeding of all animals from the calf stage so that they are finished during the most efficient and fast growing period up to two years of age. This would give a quicker turnover of cash invested in livestock and would ensure that animals are finished with a minimum of fat. Independent grading of cattle at factories and premium payments for quality are required. The only way to obtain high quality is to pay for it.

There must be aggressive marketing by meat processing industries in order to get maximum prices for Irish beef.


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Calf Marketing

B. LAWSON

Staffordshire Farmers Ltd., Wolverhampton, England.

Staffordshire Farmers Ltd. is an agricultural Co-operative with a turnover of £33,000,000 with coverage across the whole of the Midlands. The main business of the Company is in feeding stuffs and fertilisers with five specialists divisions within the Society : livestock, seeds, home grown grain, potatoes and fuel. The Livestock Division was established fourteen years ago. Initially, we were solely concerned with the marketing of pigs for breeders and feeders. The Division has changed since those early days of group marketing and the departmental turnover is now in excess of £3,000,000. The Livestock Division has now extended its activities to the marketing of all classes of livestock.

Let us first of all decide what is meant by this. It means providing the customer with what he requires, when he requires it. Unfortunately, marketing often becomes the means of disposing of an article to its best advantage. This will be explained later.

Calf numbers

It will be useful to consider some statistics as a background to this paper. During 1975 in England and Wales 4.3 million cows and heifers were put to the bull. Of these, 72% were for the primary purpose of milk production and the remainder were for the sole purpose of producing beef. Of the four million plus calves produced annually, there is an estimated mortality rate of 5%. In addition, 530,000 calves are slaughtered within one month of birth as they are not suitable for rearing purposes.

During that period 620,000 calves were reared for replacement in the national dairy and beef herds. An insignificant percentage of bull calves were reared for breeding purposes, but a significant and increasing number of calves are being exported each year for rearing in other European countries. In 1975 this figure was 105,000 but it is estimated that this will be doubled in 1976.

The remainder are made available for rearing as beef. The self sufficiency level of beef in England and Wales in 1975 was calculated at 90% which suggests that if the 530,000 calves which were either slaughtered or died from natural causes had been reared, a situation of maximum self sufficiency would have prevailed. This is of course a simplification, but illustrates the need to try to reduce the wastage of ¾ million calves per year. Finally, there are approximately 25,000 calves reared in Specialised Veal units each year.

Calf marketing

Calf marketing is a process of establishing from the retail butcher what he is most likely to supply to housewives, and then relating that observation back via the various stages of production and management to the cow.

Let us consider how that can be achieved. This is where the benefits of a producer organisation are invaluable. Through the management staff of the Livestock Division we know from the slaughtering wholesalers which carcases are in the greatest demand by their retail customers. This information is determined by the housewife. We are then able to relate that requirement to the type of beef animal capable of providing a suitable carcase. The financial aspects immediately take care of themselves, since, if the product is in demand by the customer then the retailer can sell to his advantage. Likewise, the wholesaler gets a similar financial reward from the retailer and accepts that the only means of attracting suitable cattle to his abattoir is through financial incentive, i.e. the price paid to the producer.

If it is financially attractive to the beef finisher, then the calf producer should reap the rewards of a supply and demand situation. So, having determined the series of events capable of producing success how then does an organisation like ours ensure that these principles are put into practice ?

Field staff

Staffordshire Farmers is in the enviable position of having very close links and loyalties with its farmer members. However, we are not tempted into complacency by this situation, since these links will quickly disappear if the management staff are not capable of carrying out a successful marketing operation. Consequently we have ensured that efficient and capable staff are employed and that suitable re-training schemes are regularly introduced so that staff can keep pace with the industry and its developments.

Regular contact with producers by the Field Staff ensures that the producer is informed of the market requirements. He is acquainted with the demands of the wholesaler and he will make sure that Staffordshire Farmers supply him with the correct type of stock to meet that market demand and so reap the financial rewards. Because of this regular contact with beef finishers, the department knows the requirements of each member in terms of his supplies of calves or store cattle, both in quality and quantity. This information is carefully monitored and related back to the dairy farmers and suckler herd owners in the membership with us. Again, this liaison ensures that the management knows the number of cows being put to the bull at any one time. Therefore the various calving patterns can be charted. As a result the trends of the meat industry are reflected back to the calf producer as an indication of the type of calves that are going to be in demand. Unfortunately, because the agricultural product market is so changeable and sensitive, these simple principles are aggravated and disrupted by other factors. The fact that over 70% of beef produced in England and Wales is a by product of the dairy industry means that beef is not the first consideration.

The main considerations are milk, and the continuing efforts of milk producers to improve yields and to provide a supply of replacement females. Consequently, the beef industry as such is not always served as well as it might be. However, we have to live with this situation, which is responsible for the second part of my marketing statement: "that marketing is the art of making the best use of a product produced under other influences".

The Staffordshire Farmers system of marketing calves is similar to that of other marketing groups in England and Wales. However, disposal of the majority of calves produced in these countries continues via the Auction Market.

Although this is an expensive method, with fluctuating prices due to the vagaries of a dealer controlled market, most farmers continue to support it, since they believe that it is simple and convenient. In these days of intense competition some farmers believe that it is not possible for our Co-operative to give all round benefits. Fortunately we have a considerable number of members who know differently.

Benefits to producers and buyers of calves

Let us therefore consider our alternative. A 'phone call notifies the department that a number of calves are available for collection, with all the problems of price, a buyer and transport settled by the department for the producer. The obvious benefits in allowing a better presentation of the calf, reduced stress and health hazard to the calf highlight the advantages. The allied reduction in marketing costs created by improved efficiency and reduced overheads, together with a stable predetermined price system results in improved net returns.

The benefits to the buyer are also considerable. He also has the advantage of reduced stress and health hazard to the calf. A 48 hour guarantee against ill health or death resulting from a condition evident at the time of sale gives an added insurance to the buyer. There is an understanding that if he is dissatisfied with one or more of the calves which have been delivered to him, he is at liberty to leave that, or those, calves on the lorry. The buyer's awareness of the price prior to delivery of the calves and knowledge that because of all the guarantees by which he is protected, makes him realise that we make every effort to ensure satisfaction. There are other advantages: the time saved by the buyer in not attending Auction Markets to buy calves; the doubts as to whether the type of calf which he requires will be at the market in suitable quantities and at a satisfactory price; his awareness that the calves have not been hawked around the various markets with resulting journeys of stress and discomfort; knowledge of the origin and breeding of those calves. All these factors render the marketing service that we provide attractive to the buyer.

Providing this type of service is very exacting. Instead of much of the responsibility being left to the buyer in the traditional auction market, the service places an enormous onus on Staffordshire Farmers livestock fieldsmen. Providing such a service is consequently not cheap; cheapness however usually implies inferior quality. The service is competitive and designed to be of greatest value to both buyer and seller alike.

Breed improvement

With increasing attention towards improving the marketing and processing of beef, the progressive producers of finished cattle are beginning to examine means of exerting influence over the production of improved calves for the specific demands of the meat industry. Investigations and research are being undertaken into improvement programmes. In the United Kingdom a system of identifying bulls of above average performance is operated by the Milk Marketing Board and other cattle breeding companies at the various insemination centres. Within the M.M.B. this is widely known as the "Red Star" scheme. Finished beef producers are prepared to give financial incentives to dairy herd owners to make use of such improved sires which are identified in all the beef breeds. The premium and benefits are not large but are enough to attract many dairy farmers. The finishers know that this improved production will be evident in the carcase, in particular the amount of saleable meat that the butcher can process from such carcases. The initial calf price premium will be more than covered by the returns from an improved yield. Yields of meat from beef carcases vary from 65% to 77%. A difference of 5% is common and in an average carcase of 250 kilos this represents a difference of 12.5 kilograms of meat which at today's price amounts to £8.90.

It is clear therefore that our method of marketing is sophisticated. The methods outlined are the future trends which are slowly beginning to evolve and in the next five years will assume significant status.

Calf export market

The export market in calves has become a larger factor in the calf industry in the last 18 months. In 1976 it is estimated that over 200,000 calves were exported from the United Kingdom. It is not in our longterm interests to export too many of our calves to other European countries. The tight specification demanded by these countries results in the best quality calves being exported. In the long term, it is in the interests of the country to retain calves and feed them through to finished beef, at which we are said to be the leaders in the Community. They are then more likely to be slaughtered in our abattoirs which, because of more stringent health and hygiene regulations and spiralling costs of building materials, plant and machinery, are very heavily capitalised and must be maintained at maximum efficiency and capacity. We should be studying the various opportunities of exporting meat and meat products. Thus, we can make the maximum use of our best resources.

Nevertheless, the attraction of improved market prices available for calves of export potential will ensure that whilst conditions permit this trade will continue. However, the attractive premiums for export calves cannot be acquired without considerable effort. The specification for calves suitable to meet the export demand both in terms of quality and health standard are difficult to achieve. For export from the U.K. calves must be a minimum of 50 kilos weight at the time of arrival, not at the time of removal from the farm. They must undergo rigorous health checks by Ministry officials and a compulsory period of rest and lairage prior to leaving by sea or air. The paperwork to accompany them is considerable and is checked, double checked, signed and countersigned. Calculations must be made in respect of current M.C.A.'s (the levy system interposed by intra Community trade in the form of monetary compensatory amounts). The export market requires professional expertise to ensure its success and continued viability.

For this reason, Staffordshire Farmers has joined seven other marketing co-operatives in the formation of a marketing federal known as Inter Group Livestock Limited, constituted for the purpose of attending to this specialist export market. In its first year of operation it was responsible for exporting 12,000 calves and 400 dairy heifers.

Conclusion

Staffordshire Farmers is aware of the need to work closer together in an industry renowned for its traditional independence. Inter Group Livestock Limited is an example of this co-ordinated effort.

The content of this paper indicates the intentions of Staffordshire Farmers to pursue an aggressive policy towards the improved marketing of livestock through co-operatives. It could be argued that this aggressive attitude has not always existed amongst co-operatives in general, but we believe that the next three years will show considerable achievements by the successful, and only the successful, marketing co-operatives. We have committed ourselves to this policy and we are going to make sure that it is successful.

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Arks

Present Standards of Efficiency in Beef Production

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During the period 1972-1975 cattle farming yielded the lowest income of most lowland enterprises (Table 1). The technical factors of major importance are animal performance and stocking rate. These are vital elements in the determination of income from cattle production and an analysis of these two factors in commercial practice is therefore of interest.

Table 1

Average family farm income (£) per acre by type of enterprise 1972-75

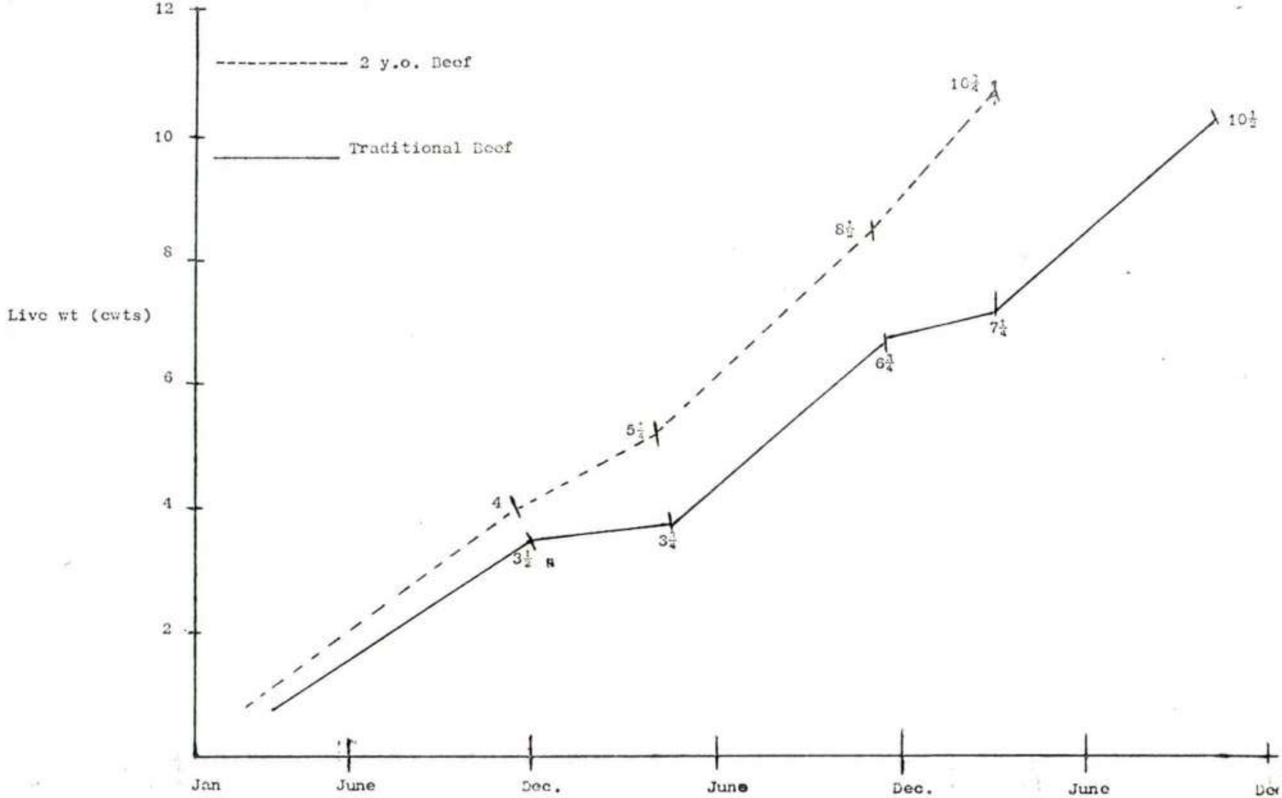
	1972	1973	1974	1975
Mainly creamery milk	29	35	31	46
Creamery milk and tillage	32	42	34	54
Creamery milk and pigs	37	47	38	67
Liquid milk	36	42	37	52
Mainly dry stock	17	21	19	28
Dry stock and tillage	21	30	30	43
Hill sheep and cattle	7	10	9	16

Source: AFT Farm Management Survey

Animal performance

Irish cattle are comparatively old when they reach slaughter weight. The June livestock census of the Central Statistics Office shows that almost 20 per cent of cattle are over three years of age when sold for slaughter or for export as forward stores. Growth curves of (i) an average bullock reared and finished in traditional fashion and (ii) a bullock finished in an integrated calf to beef system are shown in Figure 1. It is clear that the growth potential of Irish cattle is not being exploited. The average bullock is over six months older and is lighter at finishing than its contemporary on a two year old system. This is a particularly poor performance, achieved after three full seasons at grass. In addition, it requires more than twice the amount of land (1 acre v 2½ acres) to finish the average bullock than in a fully integrated calf to beef system. The nett effect of the poor animal growth rate and extensive stocking is to halve the income that is obtainable from a two year old system.

Fig. 1. Growth curves of cattle in traditional and intensive beef systems



It is also clear from Figure 1 that the two winter periods are the stages when animal performance in the traditional system is poorest, being only 20 to 25 per cent of the performance achieved in the two year old system. Quality and quantity of winter forage are the most important factors which affect this performance.

Quantity of winter forage

Ample supplies of winter forage are a pre-requisite to efficient cattle production. It is apparent from Table 2 that the national winter fodder supply is inadequate. It is therefore not surprising that the general level of animal performance is poor. No allowance has been made in these figures for winter grazing and meal feeding. These are not likely to significantly change the picture. The apparent improvement in 1975 was due to a fall in total livestock numbers rather than any increase in supply over demand.

Table 2

National winter fodder supply, and the requirements based on maintenance + ½ lb daily gain, 1971-75

	1971	1972	1973	1974	1975
Tons S.E. produced ('000,000)	1.8	1.8	1.9	1.9	1.9
No. of livestock units ('000,000)	5.1	5.3	5.7	5.7	5.2
% deficit M + ½ lb gain/day	25	32	33	33	20

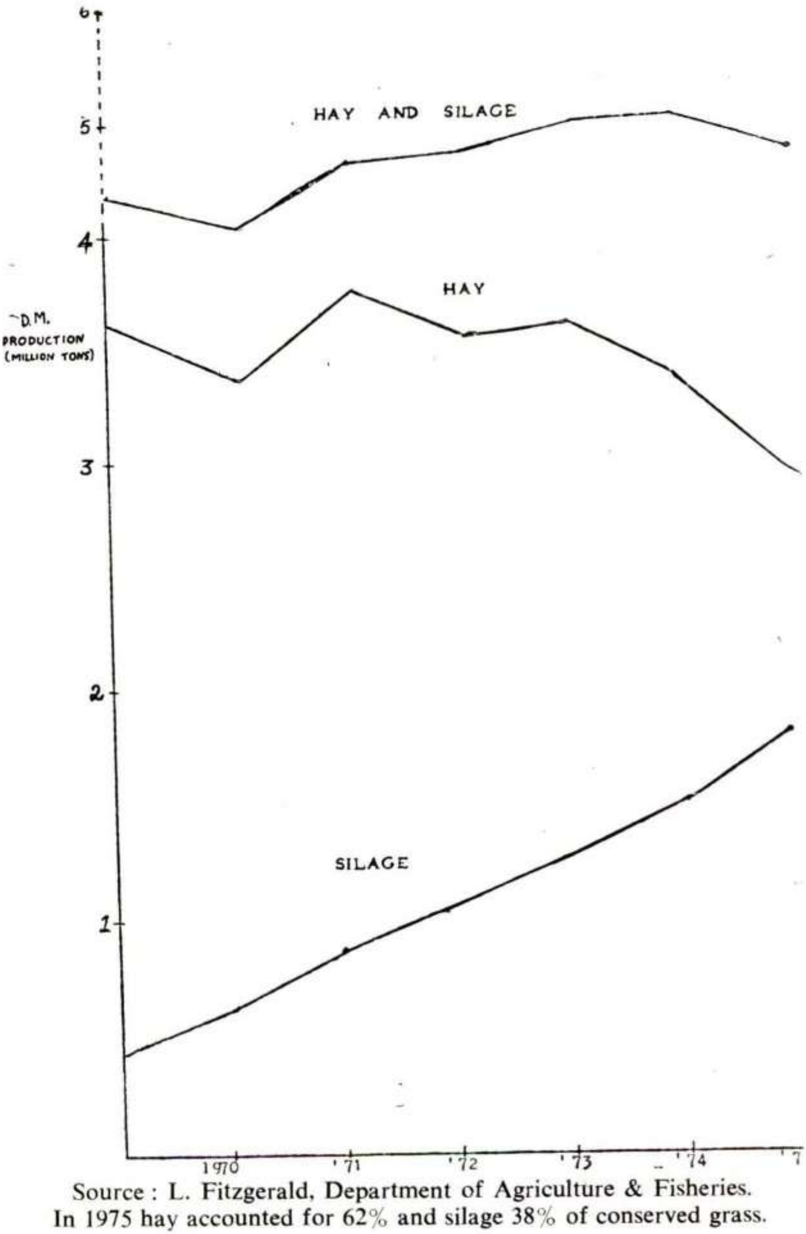
Furthermore, it appears that there is wide variation in winter fodder supplies between regions within the country, with the greatest deficits occurring in western areas. The general deficit represents about one million hay equivalent acres. Shortage of winter fodder is a major impediment to significant national improvement in the technical efficiency of cattle production.

Although the amount of silage made in the country has been steadily increasing over the past decade, hay still accounts for about 60 per cent of the national winter fodder supply (Figure 2). The task of making a high quality product in the form of hay is substantially more difficult than with silage under Irish climatic conditions. Consequently, the rate of increase in silage conservation must be accelerated.

Quality of winter forage

There is ample evidence to show that the average quality of hays and silages is poor. Sample analyses carried out by the Agricultural Institute indicate that the average D.M.D. of hay is 57 per cent while that of silage is 61 per cent. Clearly, these forages are capable of supporting little more than animal maintenance and have no place in profitable cattle production today. Results from the better commercial farms recorded

Fig. 2. Quantities of feed conserved for winter



Source : L. Fitzgerald, Department of Agriculture & Fisheries.
In 1975 hay accounted for 62% and silage 38% of conserved grass.

by the Department of Agriculture and Fisheries show that the average D.M.D. of silages is only 64-65 per cent — i.e. medium quality silage. These results have been outlined at previous meetings of the Association [1, 2] and it was shown that animal performance was poor.

Last year (1975/76) however, there was substantial improvement in animal performance on recorded farms. The average results are given in Tables 3 and 4 with the corresponding results for the previous winters shown for comparison.

Table 3

Silage quality, average results

Winter season	D.M.D. %	D.M. %	PH	Mean cutting date of silage
1975/'76	71	26	4.2	May 29
1972 to '75	65	21	4.2	June 9

Table 4

Average performance of animals on recorded farms

	Winter season	
	1975/76	1972 to '75
No of groups	33	255
No. of animals	1,650	10,437
Av. weight at start (lb)	1,070	870
Av. amount of meal lb/hd/day	4.2	3.5
Overall ADG (lb)	1.9	1.2
ADG from silage (lb)	1.4*	0.7**
DMI % of liveweight	1.5	1.2***

* based on a liveweight conversion of 8 : 1
** 7 : 1 conversion
*** DMI recorded only in 1974/'75 winter season

There was a major improvement in silage digestibility in 1975/76. Average cutting date was 10 days earlier and this is the likely reason for the improved digestibility. The higher average dry matter content is a reflection of the finer weather in 1975 at cutting time and there was a greater proportion of wilted silages in that year. Silages were generally well preserved with no differences between years.

There was also a major improvement in animal performance in 1975/76 (Table 4). The ADG from silage alone improved by 100 per cent—

from 0.7 to 1.4 lb. This was associated with the higher digestibility of the silage and with increased dry matter intake. The performance from silage alone on the top third group of farms was 1.7 lb ADG per day. This level of animal performance demonstrates the real potential of high quality silage.

It is pertinent at this point to examine the effect of silage quality on the feed costs of winter production. Table 5 contains detail of feed requirements and cost of wintering a 10 cwt bullock for 130 days on (i) high quality silage capable of producing an ADG of 1½ lb and (ii) a medium quality silage requiring supplementation with 5 lb of meals daily to achieve the same ADG. The high quality silage is cut before June 1st and the medium quality two weeks later.

Table 5

Feed requirements and costs (£) of wintering a 10 cwt. bullock for 130 days (see text)

	High quality silage only	Medium quality silage + 5 lb meals
ADG lb	1.5	1.5
Production and storage costs of silage 20% D.M. (£/ton)	6.0	5.3
Silage requirements per animal (tons)	5.8	5.1
Meal requirements (cwts) (£/ton)	Nil	5.8
Total feed costs (£)	35	53

The table shows that it costs £18 less to winter a 10 cwt bullock on high quality silage compared with medium quality silage. It also shows the relative cost of high quality silage to meal. High quality silage, therefore, reduces costs.

Many reasons are advanced for the rarity of high quality silages on cattle farms, the commonest being :

(i) the failure of the silage contractor to turn up on the date specified;
(ii) delays due to bad weather;
(iii) the belief that quantity is more important than quality.

It must be clearly appreciated that because of the rapid recline in grass digestibility at the normal silage cutting stage, a two weeks delay in cutting will change the silage from a high to a medium quality product. To consistently produce a high quality silage from old permanent pasture, the **first cut must be taken not later than May 31st** and preferably earlier. All subsequent cuts must be taken after not more than seven weeks re-growth.

Some 60 per cent of the national silage crop is cut by contractors. Contractors play an important role in silage making and they require a certain acreage for cutting to maintain an attractive income. This was achieved in the past by having a protracted silage cutting season. It would appear at the outset that the making of high quality silage with the contracting system is not feasible. However, this need not necessarily be so. Since there is a substantial pay-off from high quality silage, some of the pay-off could be used as a premium to contractors who guarantee to have silage cut by a stipulated date. This would promote greater efficiency among contractors. More farmers, either as individuals or as groups, should plan to purchase their own silage making equipment. However, before taking such action they should have clearly established the feasibility of making high quality silage in the new circumstances. There are numerous examples of farmers who have their own equipment and still fail to make high quality silage.

Stocking rate

The average stocking rate on the majority of beef farms is low. A common stocking rate for summer grazing in traditional practice is the equivalent of one 8 cwt bullock per acre producing about 4 cwts of liveweight. Stocking rate is the major determinant of output per acre. In order to examine animal performance and the effect of increased stocking rate it was decided in 1974 to set up a series of cattle stocking rate demonstrations. Three stocking rates were chosen, i.e. 18, 15 and 12 cwts of liveweight per acre at the start of grazing; all stocking rates were reduced to a common level (13 to 14 cwts/acre) at mid season, about mid-July. Each of the three stocking rates were run on the same farm each year and every effort was made to ensure equality of swards between treatments within farms. The mean date of initial grazing was April 17th while the mean finishing date was October 7th. A summary of the results is presented in Table 6.

Table 6

Average results of stocking rate trials on recorded farms 1974-1976

Stocking rate (cwts/ac)	12	15	18
Initial livewt. lb	683	679	678
Total gain per acre, cwts	5.9	7.5	8.1
Total gain per animal, lb	360	375	350
Nitrogen/acre, lb	100	110	130

Individual animal performance was not affected by the stocking rate chosen, while output of liveweight per acre was increased by 37 and 27 per cent respectively for the 18 and 15 cwts compared with the control stocking rate of 12 cwt per acre. It must be borne in mind that the usual stocking rate on the majority of farms is only 8 cwt per acre. It is reasonable to conclude therefore that output per acre can be doubled without affecting individual animal gain. There were differences in performance between farms and within farms between years. Unusually long drought periods were experienced on all farms during 1975 and 1976. Nevertheless, animal performance remained quite good even at the highest stocking rate. These demonstrations clearly showed that stocking rates of up to about 16 cwts per acre with modest inputs of nitrogen are practical.

Integrated systems of production

In Ireland production of beef from the calf stage on the same farm is rarely practiced. There is a multi-stage chain of production with the animal changing hands several times throughout its lifetime. There is a strong trading pattern which diverts attention away from technical efficiency factors. Winter feed shortage is accentuated because a farmer is never really sure of how many cattle he will over-winter and often finds himself with more cattle than he has sufficient feed for. Trading patterns produce unstable incomes from year to year because of the large effect which buying and selling have on output. This is shown in Table 7. Systems No. 1 and No. 2 are typical trading systems while No. 3 is a fully integrated one and Nos. 4 and 5 are partly integrated. Details of these systems have been published[3].

Table 7

Effect of cattle system on income per acre

System	± £1 per cwt in buying price	± £1 per cwt in selling price
No. 1. Summer grazing	± 16	± 23
No. 2. Over wintering	± 30	± 37
No. 3. Calf to beef (24 months)	± 10*	± 11
No. 4. Weanling to beef (18 months)	± 10*	± 13
No. 5. 12 months system (store to beef)	± 8	± 17

* ± £10 per head

The sensitivity of systems 1 and 2 to buying and selling is obvious and is in marked contrast to the other three systems.

Table 8 shows clearly the great variation in a trading system and confirms the point made regarding over-wintering in Table 7.

The future

Production per acre in cattle farming enterprises is generally poor. Farmers and agricultural advisers must aim for improvements in standards of silage quality, stocking rates and general levels of husbandry. Furthermore, the beef production chain needs to be streamlined, so that

Table 8

Gross margin per acre from winter finishing system

1972/73	1973/74	1974/75
£101	£47	£212

Source : B. Hickey, An Foras Taluntais, Sandymount Avenue, Dublin

technical efficiency is rewarded. The ideal is the production of beef from the calf stage on the one farm. Alternatively, the production of beef from the weanling stage on the same farm is recommended. In this regard, there are lessons from the pig industry. It is considered that a proportion of farmers would rear the calves and sell them as young cattle, say at 12 or 18 months, on a **contractual** basis to farmers who would finish them. This kind of development will require promotion and encouragement by the meat plants. Already one meat company, namely, I.M.P., has taken steps in this area. Moreover, factories must start paying for meat on a standardised quality basis. This would create the incentive necessary to produce quality beef in the form of bull beef, two year old bullock beef and beef from continental type animals. This development would be in the long-term interest of meat plants and would facilitate access to the higher priced markets in Europe. If meat factories were to take this action producers would respond by producing younger and better quality beef. There is the example of a few years ago when producers embarked on a bull beef pilot project. A major responsibility, therefore, rests with the meat plants and their actions will profoundly influence the development of cattle production.

Lending institutions must also plyay a more positive role in helping to promote a more integrated form of beef production.

Finally, farming organisations could use their expertise and influence in helping to change the face of cattle production in the country.

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The Role of Co-operatives as Large Scale Calf Rearers

B. RAFFERTY

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Lough Egish Co-operative has had the experience over three consecutive years of rearing nearly 5,000 calves on one farm. We are beginning to understand the full significance of this exercise. Our interest in central calf rearing arose from the problem of wide fluctuation in calf prices. A £20 drop in calf prices is equivalent to a reduction of 2p a gallon in the price of milk. The Co-operative decided to investigate how this year to year variation in calf prices could be overcome.

Centralised calf rearing

In 1973 a study group from Lough Egish Co-operative went to the Netherlands to examine central calf rearing there. Specialised calf rearers in the Netherlands take in dairy herd replacements on a fosterage basis and rear them to the point of calving. There are two main advantages in this arrangement : (1) the specialised calf rearers were reducing mortality rates by 50%; (2) they were bringing these replacement heifers into the herd as milkers at good weights at two years of age. They were specialising in the same job year after year on the same farms and they were overcoming disease problems by very careful management and by strict policing of disease risks.

We decided that we would attempt to rear calves in large numbers, with similar success.

Initially, whilst we were not ready to start rearing replacement heifers, we considered it important to help our milk suppliers to get the best results from their bull calves and to give our milk suppliers a good return from them. Our approach was to bring some stability into an industry that is notoriously short of it. We bring these calves, mainly as a by-product of the dairy industry through an effective programme of calf to beef rearing, with the minimum of waste, the minimum of risk and the minimum changes of ownership. This year we require 1,000 calves and we are at the moment in the process of buying them at various collection points around the Lough Egish supply area. To obtain 1,000 calves we must contact the owners of more than 4,000 cows. On the assumption that half the calves born will be heifers and half the remainder will not suit our purpose.

Calf husbandry

The calf rearing system is operated by Vincent McGee who farms at Ardee, Co. Louth and has gained wide experience in rearing 5,000 calves.

But for the moment what I propose to do is to outline some of the management steps and some of his husbandry techniques for rearing large numbers of calves.

(i) **Biestings**

Lack of biestings for the calf within the first 12 hours is very likely to cause health problems. Biestings have essential antibodies to protect the calf against several diseases.

(ii) **Milk replacer**

The next rule is to leave the calf on whole milk for not less than 10 days. Milk replacer is then gradually introduced; we use 1 lb per gallon of water and feed two pints twice a day for the first week. In the second week we feed three pints twice a day and in the third week a gallon a day, fed twice daily. At about four weeks and feeding a gallon a day once a day feeding can be practiced. But this does not mean that calves are not inspected till the following morning; they must be seen a couple of times a day; early detection of disease is essential for success.

We favour the feed barrow for feeding replacer with eight calves sucking at a time. A calf sucking milk replacer through a teat rather than drinking is less likely to get scour. Calves can be weaned from replacers at eight weeks. At weaning time the meal intake increases to a minimum of 4 lbs per head per day.

(iii) **Meals**

During this period of introducing milk replacer the calf will not be fed to full appetite and consequently will consume small amounts of fresh meal pencils when offered. A calf on cow's milk continuously will be fed to appetite and will not eat meal pencils. The earlier that meals are offered to the calf the better and should be offered fresh each day.

(iv) **Water and hay**

Calves should have fresh water available each day. Good hay should be offered from about 4-5 weeks onwards.

(v) **Housing**

The calf house should be dry, airy, well ventilated and most important of all it should be free of draughts. This may require only a bale of straw in the right place. About 10 sq. feet floor area per calf is allowed. A hard core floor can often give better drainage than concrete floors. But irrespective of type of floor it is important to keep a dry bed under the calf. Calf houses should be cleaned out and disinfected as soon as the calves are turned out to grass and they should be rested before the next batch of calves arrive.

In large units a special pen or isolation area with an infra-red lamp should always be provided for sick calves. All calves with scours or pneumonia should be isolated immediately.

(vi) **Health**

The main health problems are scour, pneumonia, lice and worms. The most common cause of scour is overfeeding in early life. Overfeeding causes nutritional scours which, while probably in themselves are not very harmful, can give rise to bacterial scours. Every calf that shows signs of scour should be taken off replacer immediately and be put on an electolyte mixture.

A calf with a nutritional scour shows no temperature change but there is a temperature change with bacterial scours. Virus pneumonia is caused by lack of ventilation and draughts and is usually found in damp, stuffy calf houses with high condensation. Apart from the risk of death, an affected calf will thrive poorly.

(vii) **Summer grazing**

At twelve weeks of age calves are turned out to grass during the day. With shelter, they can be allowed out day and night after a few days. After turnout, calves are fed 2-3 lb meals/head/day. If heifers are required to calve at two years of age, feeding some meal through the first summer may be necessary unless grass is very good. Growth rate for all calves should be maintained at one and a half lbs per day. A heifer should be 600-700 lbs liveweight at bulling. The importance of early calving must be emphasised because the early calf on average will be 200 lbs heavier in October than the late calf. January calves, for example, should be generally 550 lbs by October/November.

Grass for calves should always be young, leafy and nutritious. Calves should be rotationally grazed either in front of cows or in individual paddocks. They should be transferred at least once a week to fresh grass. This may require subdivision into small paddocks if they are not being grazed ahead of cows; an electric fence controls calves very effectively.

The grass should not be allowed to become stemmy. If cows are not grazed after the calves the grass will require topping several times during the year. The feeding quality of stemmy grass is poor, so nothing is lost by topping and the growth of young leafy grass is promoted.

Clean drinking water should be provided.

Calves should be worm dosed on turn-out to grass and dosed each month afterwards. This may appear expensive but a calf that does not thrive is also very expensive. By regular dosing, hoose and stomach worms are effectively overcome.

Calf quality improved

The impact of the Lough Egish Calf Scheme on the farming area has been obvious. We have shown our intent by buying 5,000 calves at an average price of about £50. Farmers have responded accordingly and now we can see the difference particularly in the quality of the calves available.

On arrival at 14-21 days they are vastly superior to those of three years ago. This is mainly a reflection of better rearing in the first 10 days. We are also conscious of a great improvement in breeding. Having demonstrated that there is a reliable market for the good quality Friesian bull calf, we are being supplied with comparative ease.

The existance of fixed points for delivery of calves is a valuable aid to management. On a one-man farm the farmer has the advantage of a fixed time and fixed place for delivery without wasting time.

Calf mortality is 1% and there is a further 1% of calves lost on grass up to the age of 12 months. In relation to national averages this is exceptionally good.

We are pleased that the Livestock Division of Lough Egish, which was started primarily as a service to our suppliers, left the Co-op. with a profit of £43,000 in 1976.

Integrated calf to beef production

In an attempt to reap the full benefit from our calf rearing enterprise we should now be examining integrated calf to beef livestock systems.

The Agricultural Institute has reported production targets for the steady growth and early finishing of Irish cattle. These targets have become realities in our Co-operative. We have bulls for slaughter at two years old weight 12-12½ cwt. They are the product of a planned production pattern with no setbacks arising from changes of farming systems and changes of ownership.

For efficiency and profits in livestock production we must think in terms of a much closer relationship between the breeder and finisher of cattle.

If the finisher is investing for example £350 in an animal and £100 in housing it, he cannot afford to change his luck. Is there any sense remaining in a situation where he has no more than a rough idea of what his store cattle will stand him the following autumn? The time has arrived to examine very closely the advantages of becoming a shareholder in a weaning pool. In such a pool of weanlings we can estimate and budget on the 1st October 1977 the cost of cattle on October 1st 1978.

In conclusion, I believe that the Co-ops. have a role in setting up the kind of structure which allows such pools or contract arrangements to function. I think that it is not necessarily a job for the dairy co-operative. Equally, the meat factories could have field staff to provide liaison between farmers. Alternatively, a completely new form of co-operative could be set up which would draw together the interests of the producers and the fatteners of cattle.

The ultimate objective is that cattle would move from producer to fattener to factory in three efficient stages and the entire industry would be the better for that.

A Development Programme for Large and High Yielding Dairy Herds

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This paper describes the programme that is in progress at the Edinburgh School of Agriculture which is planned to meet the needs of the majority of dairy farmers in the East of Scotland. It is based on information both from research and commercial farm experience and is promoted in critical investigations in the University herd and through recording in commercial herds. It provides the basis for the extension activity which is projected by specialist advisers through the general advisers in the field. The whole range of activities from teaching to research, development and advisory activity is integrated within the same organisation, combining a range of specialist disciplines and engaging in joint activity with Research Institutes.

Milk production in the East of Scotland : the context for development

In the East of Scotland there are now some 500 dairy herds, with an average size for 'one-man' units of 90 cows and for 'two-man' units of 145 cows (Bell and Dodds, 1976). About threequarters of the herds are milked in Herringbone parlours. Approximately one half of the parlour-milked herds in the Development Programme are housed in straw courts, the other half in cubicles, usually on sawdust (Bell, Brocklehurt, Miller, Prescott, Nicholson, Pearson and Mathieson, 1976).

Two-thirds of the herds are predominantly British Friesian; the remaining third are Ayrshire (Bell and Miller, 1976). The number of Friesians is increasing and Canadian Holsteins accounted for 1% of dairy bulls in 1975/76.

A notable feature of the Scottish Dairy Industry is the less widespread use of A.I. than in England and Wales (SMMB, 1976) and the larger size of Scottish herds has been suggested as being a possible influencing factor. Performance of recorded herds and the relative use of A.I. and natural service are summarised in Table 1.

Intensive grassland use at a stocking rate of approximately 2.5 cows/ha (a cow to the acre) is characteristic of the sample of 25 costed herds (Dodds, 1976). Most large herds use silage at the basis of winter feeding, and of the 120 samples analysed by the Advisory Nutrition Department

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[1] Dr. C. Smith, Animal Breeding Research Organisation, Edinburgh

* The average for all recorded herds in the East of Scotland was 1000 gallons (4500 kg).

Table 1

(Breed structure and milk yield of the Scottish dairy herd (1975)

Breed	%	Yield (kg)	Fat (%)
Friesians + Friesian crosses	52	4850	3.7
Holsteins	1	5560*	3.8*
Ayrshires	47	4440	3.9

* England and Wales

Use of A.I. in Scotland compared with England and Wales

Scotland		England and Wales
16%	of herds use only A.I.	65%
32%	of herds use only natural service	—
52%	of herds use A.I. and natural service	35%

half were classed as 'Grass Silage' with a mean DM content of 24% and half as 'High Dry Matter Silage' of 33%. The nutritive values of these silages were on average 11 and 10 MJoules ME/kg DM with 15 and 13% CP, respectively. Wilting is common practice and additives are used to a limited extent. The use of precision-chop forage harvesters is increasing; already over 50% of the silages analysed had been harvested in this way. Many of the larger dairy units are changing from self-feed systems to trough feeding using forage wagons.

Milk sales last year in costed herds averaged 1100 gallons (5000 kg)* with a concentrate use of 29 cwt (1500 kg), a margin over concentrates of £312/cow and a gross margin/cow of £250 (Dodds, 1976).

Over recent years (with the exception of a notable period of six months in 1974/75) the relative price of milk and concentrates has justified—

(i) liberal feeding of cows in early lactation;

(ii) generous feeding of cows in mid-lactation when they have been yielding over 5 gallons (22 kg) per day).

With profitability being progressively threatened as overhead costs inflate more rapidly than milk prices, producers have in the main sustained net incomes by securing higher milk yields per cow. In most instances, this has been associated with higher levels of concentrate feeding.

The target for the future is likely to be 600 - 700 kg (1500 gallons) of milk sold/cow/annum from 100 to 200 cow herds with initially 0.30 kg concentrate/kg milk, gradually improving with higher silage intakes and more efficient feeding practices to 0.25 kg concentrates per kg of milk.

Development of the Langhill herd

The intensification of production from the University herd at Langhill has foreshadowed the trends in the industry at large. Ayrshires have been progressively replaced by Friesians and the self-feed silage system has been partially replaced by forage-box feeding, permitting higher levels of concentrate feeding and resulting in higher yields.

The herd of 175 British Friesian cows is stocked at slightly more than 2.5 cows/ha of grass and milked by two men with week-end relief. Last year (1975) just over 1268 gallons (5757 kg)/cow were sold with use of 0.32 kg concentrates/kg milk; this from a herd containing an unusually high proportion of heifers and with the cows averaging close to 1400 gallons per lactation.

The increase in yield (from 950 gallons in 1970, to 1040 gallons in 1973 and 1270 gallons in 1976) has been associated with increased feeding of concentrates—mainly in the first 100 days of lactation—and there has been a substantial increase in margin over concentrates to £350/cow in 1976 (see Table 2). This improvement and the prospects for further increases in yield reflect not only the genetic potential of the cows and improvements in feeding, but also depend on the high standard of livestock husbandry provided by a dedicated dairyman.

Table 2

Langhill production and margin over concentrates

	1970	1973*	1976
Milk sold/cow (galls)	950	1040	1270
(£)	173	227	500
Conc. fed/cow (cwt)	23	30	36
(£)	32	70	150
Margin over conc. (£)	141	157	350

* start of the project

The establishment and objectives of the Langhill project

The development project was initiated at Langhill in 1973. Critical investigations in this herd are the central feature of the whole development programme and serve as a focus of attention for extension activity.

The objective of the development programme for the herd is to use it as a 'test bed' for the evaluation of the techniques the individual dairy farmer can apply to the breeding and management of a large and high yielding herd.

The project involves **genetic improvement** and an emphasis on the **management practices** which will best sustain high yields.

The genetic improvement programme is being developed jointly by staff of the School of Agriculture and the Animal Breeding Research Organisation. The evaluation of management includes a significant veterinarian involvement. The project receives substantial financial support from both the Scottish Milk Marketing Board and the Milk Marketing Board of England and Wales.

Genetic improvement

The improvement of the genetic potential of dairy cows for high yields of milk and milk solids must be based on production records and the selection of bulls on the milking performance of their daughters. Selection of bulls is most effective when undertaken in a wide spread of herds by Artificial Insemination. The individual dairy farmer can improve the genetic potential of his own herd by consistently using semen from proven sires rated well above average on ICC (based on the performance of their daughters). Intense selection of females in large herds and still more from a large **number** of recorded herds can also contribute to genetic improvement.

The Langhill project has been established to **measure** and **demonstrate** the genetic progress towards higher yields of milk and milk solids that can be made by an individual herd that sets out to make full use of production records and intense selection of breeding stock.

The main features of this part of the project are :

(i) Emphasis on selection objectives based on performance records.

(ii) Establishment of a 'selected herd'; involving both selected heifers from a wide range of herds throughout the U.K. as well as selected homebred heifers.

(iii) Use of semen from a limited number of the most outstanding progeny tested bulls for breeding heifer replacements.

(iv) Selection of cows on the basis of "indexed" breeding value, for breeding replacements; and minimisation of cow wastage rates.

(v) Evaluation of genetic progress by comparison with a genetic control herd.

Selection objectives

Selection of bulls and cows is principally on yield of total milk solids. In the first two years of the project information on milk fat yield was generally available, but comparable information on milk protein yield has only become available more recently. The principal feature of selection will henceforth be protein production.

Consideration was given to the possibility of selecting for efficiency of production rather than yield as such, but the information on which to base bull selection for this characteristic is not available. However, the relationship between yield and efficiency of feed conversion will be monitored directly in selected cows whose bulk (total) feed intake will be recorded, and indirectly in all cows by expressing yield relative to liveweight and also recording condition score at different stages of lactation. It is of crucial importance that there is identification of those cows that are high yielding because they are large and have a large feed intake; those more moderate in size and intake that sustain high yields by mobilising fat in early lactation and replacing it later; and those which have a high intake of feed relative to liveweight and overall are likely to convert feed into milk more efficiently.

Objective criteria for culling on the grounds of illhealth or disfunction will be applied by veterinarians. The inter-relation between selection for high production and length of productive life is a feature of particular interest.

Features of type are being assessed by the British Friesian Cattle Society, so that the association between variation in production and type can be monitored.

Herd establishment

Contract matings between exceptional cows in a wide spread of herds and the best proven sires are already arranged by the Milk Boards in order to obtain young bulls for progeny testing. The Langhill project has negotiated with herd owners to purchase heifer calves from a selection of these matings. This will permit an initial comparison to be made between the selected 'purchased' heifers from the 'National herd' and selected 'homebred' heifers. When the selected herd is fully established it will be based equally upon purchased and homebred heifers (85 of each).

A comparison of the ICC's of the sires and productive performance of the dams for the first 50 purchased heifers and their homebred contemporaries is presented in Table 3.

Table 3

Herd establishment : heifer calves from herds throughout U.K. Contract matings : arranged by M.M.B. and Langhill for production of bulls for progeny testing

Genetic potential		
Sires	50 Purchased	50 Homebrtd (contemporaries)
No. bulls	31	15
ICC milk (kg)	+ 253	+ 236
ICC fat (kg)	+ 11	+ 10
Dams		
1st lactation (kg)	5170	4510
4th lactation (kg)	6980	6160
	Final establishment	
85 Purchased	—	85 Homebred

Yields of the 18 purchased heifers which calved at 25-26 months of age and which have completed their first lactations, have more than confirmed expectations that they would yield substantially more than their homebred contemporaries. It should be noted that much of their expected advantage is associated with the apparent superiority of their dams. So far small numbers are involved and the actual advantage of the purchased heifers is **not** significantly different to that expected and is associated, in part, with their heavier liveweight at calving. The yields of both homebred and purchased heifers have averaged over 500 kg (1100 gallons).

Sire selection

The sires selected for use on cows in the herd are the THREE British Friesian bulls with the highest ICC's for protein yield, that are currently available nationally through A.I. and are based on adequate weighting. Bulls are replaced as soon as better candidates become available and the extent to which any one bull is used in the herd is kept under constant review.

The minimum selection standards that apply are shown below :

ICC Milk	ICC Fat	ICC Protein	Weightings
+ 250 kg	+ 10 kg	+ 10 kg	25

The three bulls recently selected for use have ICC's for protein almost double the standard, e.g.

	ICC (14/2/77)	Weighting
Terling Conductor	+ 17 kg	(56)
Chapelry Winpad 2nd	+ 17 kg	(28.5)
Brinbower Clansman (limited use)	+ 18 kg	(26)

Heifers also are bred to a proven Friesian bull which not only meets the minimum selection standard for ICC but also has a progeny test record of minimal calving difficulties, e.g.

	ICC	Weighting
Collycroft Password	+ 11 kg	(299)

Dam selection

In order to more precisely identify the potential breeding value of each cow in the herd, a system of cow INDEXING is used which combines with due weighting all the available information on —

(i) the individual production records
(ii) the ICC of the Sire
(iii) the performance of the Dam (and if possible SISTERS and DAUGHTERS).

Currently indexes for each cow are updated annually and expressed as shown below :

	Lactations	index (kg) Milk	Fat index (kg)	Weighting	Type score
L. Clover 10th	4	+ 599	+ 23	0.76	G
L. Sylvia 7th	3	+ 110	+ 5	0.74	G
L. Frances 7th	7	− 262	− 9	0.78	G+

Up to the present the best 70% of the cows have been used for breeding replacements. Attention is now being directed to means of reducing wastage due to infertility and ill health in order to permit a greater intensity of selection for yield of milk and milk constituents.

Evaluation of genetic progress

A 'genetic control herd' is currently being established, in which 45 cows will be maintained, by random mating and culling, at a stable genetic level. The herd is based on a selection of 30-35 of the older cows already in the Langhill herd in 1976 (25% of all the cows). These cows and their progeny will be mated with a bank of frozen semen which has been laid down from 50 young British Friesian sires, randomly selected from the bulls entering the National A.I. progeny testing programme in 1976.

These 'control' cows will calve contemporaneously with 'selected' cows and be subject to identical feeding, management and culling procedures. The difference in production between the two herds should provide an estimate of genetic progress, in the selected herd and a basis for comparison with the National A.I. stud.

Evaluation of management practices

Associated with the breeding programme are investigations of those features of feeding and management that are required to sustain high lifetime production. The objective of this part of the programme is to critically evaluate production records from the herd, to identify environmental factors limiting the expression of the cows' genetic potential and to develop improved management practices to overcome these limitations. A team of specialists in Animal Production, Ruminant Nutrition, Veterinary Medicine and Farm Management are currently involved with this.

Heifers are bred to calve for the first time at about two years of age and their performance is being intensively recorded (e.g., milk yields, regularity of calving, regular weights, health and length of productive life). Particular attention is being directed to the relationship between the shape of the lactation curve, changes in body weight and condition, as well as the quality of the available feed. In future, total feed intakes of selected cows will be measured at different stages of lactation.

Calving at two years of age

The potential advantage of earlier calving at about two years of age are : reduced production costs, land, working capital and housing requirements (MLC -MMB, 1976). For example, the maintenance requirements to produce a down-calving heifer of 1100 lb (500 kg) are reduced by one-third if age at first calving is reduced from three years to two years. It is, however, evident from bull progeny testing that the majority of heifers in commercial herds calve about 30 months of age and many still calve at closer to 36 months (SMMB, 1976).

The selection of age at first calving is much influenced by the risk of dystokia and calf mortality. The incidence of dystokia in heifers is usually double that of cows and increases when heifers are calved younger than 24 months.

The management guidelines to which we operate in this respect are —

(i) A minimum bulling weight of 750 lb (340 kg)
(ii) heifers given two opportunities for insemination with a selected Friesian sire, proven to sire small calves
(iii) follow-up with an Angus bull
(iv) condition score 6-8 weeks pre-calving of 3
(v) minimum pre-calving weight of 1100 lb (500 kg)
(vi) minimum post-partum weight 1000 lb (450 kg).

In order to sustain a uniform level of milk production from the herd throughout the year, two-thirds of the heifers are bred to calve in September/October and the remaining third in February/March. Weights at first insemination have averaged over 380 kg and post-partum weights 460 to 520 kg at 25-27 months. The use of a bull that sired '90 lb calves' posed some problems with one of the first groups of heifers which calved in overfat condition, but more recently the use of a selected bull siring '75 lb calves' has resulted in very few difficulties. Effective bull selection and close control of pre-calving condition must go hand in hand with a successful reduction in calving age.

The first lactation yields of heifers in the project are currently averaging over 5000 kg. The consequent effects of such high yields, on subsequent weight gain, rebreeding, calving interval, performance in later lactations and overall lifetime production will be of particular interest.

Feeding system to sustain high yields

(a) **Subdivision of the herd**

The herd is currently managed in two groups; an early lactation group and a mid/late lactation group. The former receives preferential treatment in terms of feed quality and availability. Cows move from one group to the other in mid-lactation when they decline below 20 to 25 kg in daily milk yield. For the future, an improved building lay-out will enable the herd to be managed in three groups, matched for season of calving. The intention is that the majority of cows will remain in the same group with other cows at the same stage of lactation throughout the production cycle.

(b) **Grazing**

The two groups each graze on separate areas, each subdivided into 21 x 1 day paddocks, at an initial stocking rate of 5 cows/ha. The early lactation groups graze the area closest to the steading. Some of the grazing paddocks may initiallly be cut for silage and as the season progresses grazing intensity can be reduced somewhat by removal of dry cows from the second group. In late July - early August onwards grazing extends outside the original paddock area and on to silage aftermaths. The need for this is especially critical in dry years.

In the autumn period of the past year, extra attention has been given to the 40 cows in the critical early stage of lactation; both by ensuring that they have the best grazing and arranging for an extra late afternoon feed of concentrates (this is commented on further later). Kale is introduced into the diet of the whole herd in the autumn and provides an intermediary for the change from grazing to winter feeding on silage.

Silage feeding

(i) **Early lactation group**

In the winter period the early lactation group (of 70 to 80 cows) receives silage *ad lib.*. dispensed into a trough once-a-day by a Kidd forage box. Concentrates are fed twice-a-day in the parlour and in addition concentrates and potatoes or dried beet pulp are fed twice-a-day (mid-morning and early evening) in the trough. Allowances of concentrates in the trough are consumed on a group basis at a level that is assumed to be equivalent to 5 kg concentrates/head. At each milking, cows receive individual allowances of concentrates that rise to 5 kg/cow/milking over the first three to four weeks of lactation and then, as cows decline from peak after 8 weeks, may be adjusted down to 3 kg/cow/milking depending on yield.

In the early stage of lactation cows with a potential to yield 35 kg of milk/day may receive as much as 15 kg concentrates. In this situation, every care is taken to ensure they are also able to consume at least 5 kg DM/head/day of silage.

(ii) **Mid/late lactation group**

This group has continuous access to self-fed silage, from which they are estimated to consume 8 to 9 kg DM/day. Brewers grains (wet) are fed once each day in the trough to provide a further 2 to 3 kg DM and 5 kg of concentrates are fed in the parlour to cows yielding 20 kg or more/day. It is recognised that the high forage low concentrate diet (or indeed the all forage diet) of lower yielding cows may be deficient in phosphorus. High phosphorus minerals are, therefore, made available on a free choice basis as well as being incorporated into the concentrates.

The implications of this feeding programme in relation to a group of cows calving in mid-winter are illustrated in Figure 1.

(iii) **Complete diets**

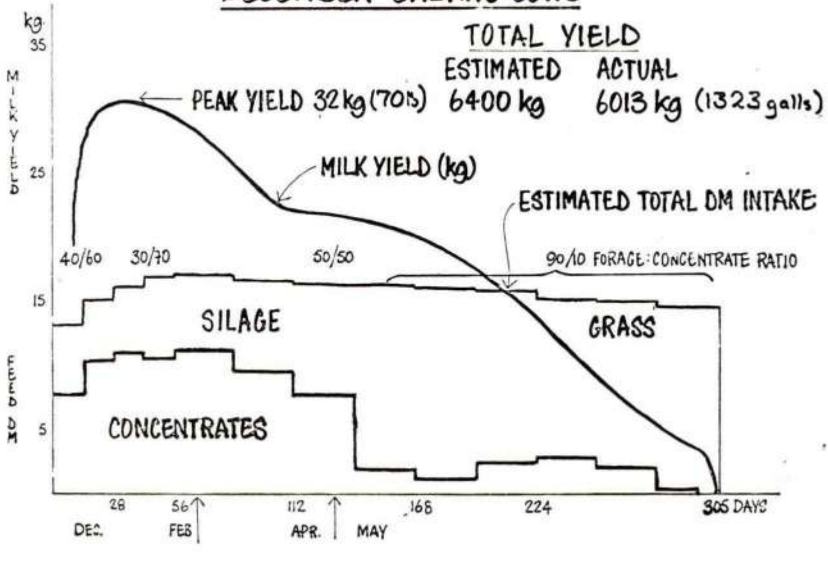
For the future, consideration is being given to adopting a 'complete diet' feeding system, using a mixer wagon that will produce a thorough mix of :

Precision chopped silage
homegrown cereals
potatoes or beet pulp
protein/mineral supplement

The advantages of this in nutritional terms should be most evident with the high yielding early lactation cows in terms of more rapid and consistent attainment of a high energy intake with minimum risk of digestive upsets. However, once the capital investment has been

Fig 1

DECEMBER CALVING COWS



made it will be most convenient to use the system for all groups of cattle. The saving of labour, improvement of working conditions for the dairyman, replacement of bought-in concentrates by homegrown cereals and simplified control of feeding by management are all major attractions.

The critical pre-condition is that building layout must enable the herd to be sub-divided into at least three groups, with adequate trough space for each cow.

It is anticipated that at any one time three diets, for early lactation (first 100 days), for mid lactation and for late lactation cows, will be fed. Formulations will need to be adjusted periodically to allow for the variation in the nutritive value of the silage, the observed level of intake of the total diet and the range of yield of cows in the group. Adequate provision for subdivision of the herd will be essential in order to prevent low yielding cows becoming excessively fat on unduly concentrated diets or under-feeding of potentially higher yielders.

Herd management control

The milk yield of each cow in the herd is recorded weekly. Cows are weighed at fortnightly intervals in early lactation and monthly intervals thereafter. They are condition scored at calving, 8 weeks and 16 weeks after calving, and at drying off. This information, together with regular analyses of the bulk feeds in the diet, is used for the evaluation of management practices. The comparison of predicted milk yields with actual performance is the key feature of this approach. Lactation curves for heifers and cows of different months are being accumulated in order to develop standard curves for prediction purposes.

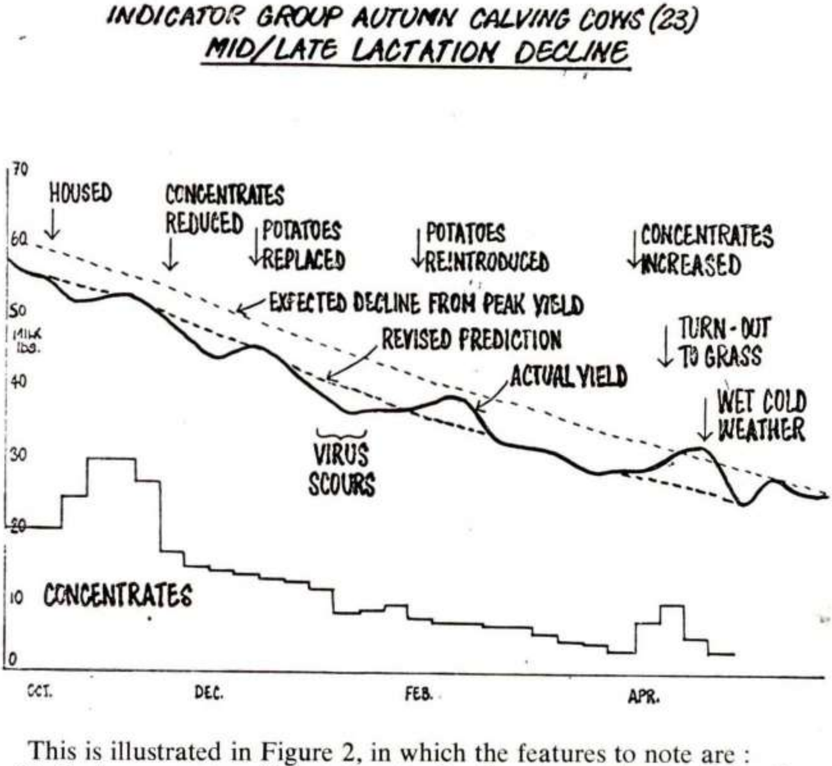
The evaluation of management has two components :

(i) evaluation of current performances as an immediate aid to management

(ii) evaluation of retrospective performance providing information on which to base development and future policy.

Current evaluation involves using the records from an INDICATOR GROUP of 10 to 20 cows, which have calved within a 14-day period. Attention focuses on the rise to peak and the level of peak yield attained and then the rate of decline of yield in mid-lactation. Changing milk yields are graphed against **calendar dates** and related to changes in feeding and management. An expected rate of decline of 2.5% per week is used as the basis for comparison.

FIG. 2



This is illustrated in Figure 2, in which the features to note are :

(i) Performance in mid-lactation (at 6 gallons/cow/day) was already at a consistently lower level than that estimated from actual peak yield, because of an unusually rapid decline from a high peak referred to later).

(ii) In October, the transition from grazing to full winter feeding was satisfastory.

(iii) At the end of December, potatoes were replaced by concentrates, without depression of yield.

(iv) In January, a virus infection in the cows caused scours and a yield depression.

(v) Re-introduction of potatoes in February, probably coincided with recovery of appetite after the infection and raised yields.

(vi) In April, the effect of turn-out to grass is confounded with the previous increase in concentrate feeding. An extra 0.3 kg concentrates/cow/day resulted in slightly less than an 0.3 kg response in yield; not an economic response at current prices.

Retrospective evaluation is undertaken with successive monthly calving groups of 10 to 15 cows. Milk yields are plotted against **stage of lactation** to identify lactation curves. Liveweight changes are related to these, as are concentrate allowances and periodic records on cow condition and bulk feed quality (and availability).

A summary of recorded information related (for simplicity) to cows calving in the autumn, mid winter, late winter and spring is presented in Table 4. Attention is directed to peak milk yield, rate of decline post-peak and total lactation yield; cumulative concentrate consumption in

Table 4

Retrospective evaluation : 1974-1975

Average peak yield 32 kg ± 0.5 at 33 days
rate of decline from peak to 112 days 1.5 - 3.0%/week

	Peak (kg)	Decline (%)	Lactation (kg)
August/September	32	2.7	5300
October/December	32	2.2	5700
January/March	32	1.7	5800
April/May	38	2.0	6700

Autumn calvers — High peak 34 kg lactation 5300 kg
Low peak 30 kg lactation 5600 kg
Suspected underfeeding on autumn pasture

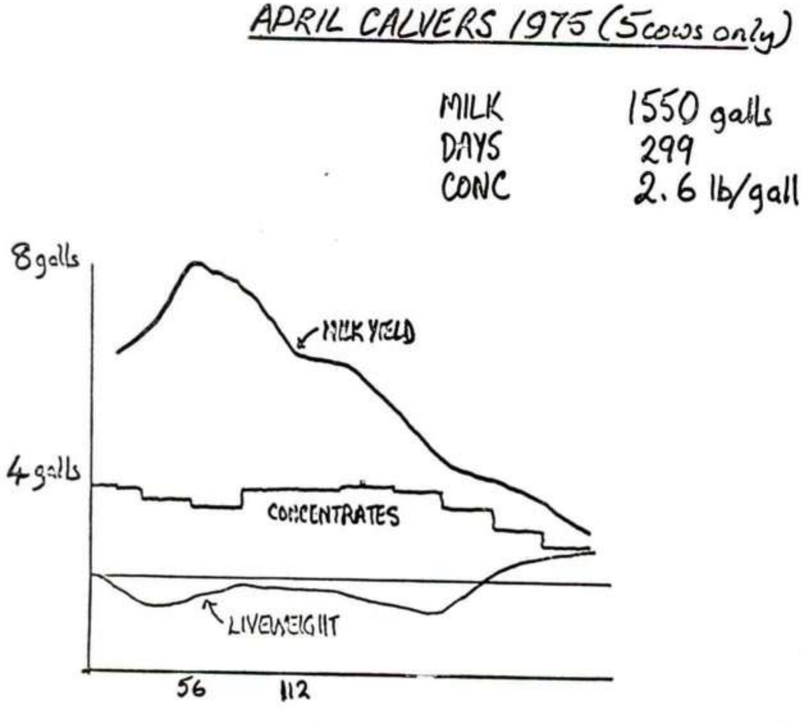
early lactation (up to 112 days) and concentrate/milk ratio are also summarised. The average peak yields for all the cows was 32 kg ± 0.5 kg attained at about 35 days after calving and with rate of decline from peak ranging from 2.0 to 2.9%.

The performance of autumn calving cows and of the spring calves merit further comment.

Spring calvers

It is a feature of the spring calvers that they have the highest peaks, slowest rate of decline and the highest total yield associated with quite moderate levels of concentrate feeding (see Figure 3). However, in this particular case the cows were older than average; (6th lactation) had

Fig. 3



longer dry periods (72 days) and calving intervals (400 days) and were, of course, producing milk in early lactation from spring grass. Their performance does, however, illustrate the potential of grazing and moderate levels of concentrate feeding (0.25 kg/concentrates/kg milk) with the high yielding, spring calver.

Autumn calvers

Autumn calving cows (August/September), while they had similar peak yields to the average, had a markedly faster rate of decline close to 3% per week. In this respect, those cows which calved in the autumn and had above average peak yield declined so rapidly that their final lactation yield was in fact lower than those with a lower peak yield, viz.,

Autumn calvers—Higher peak 34±0.4 kg lactation yield 5298±39 kg
—Lower peak 30±0.4 kg lactation yield 5569±118 kg

By contrast, winter calving cows with a similar peak yield had total lactation yeilds considerably higher than the autumn calvers, viz.,
Winter calvers (35) peak yield 32±1 kg; lactation yield 5720±120 kg
Autumn calvers (18) peak yield 32±1 kg; lactation yield 5278±193 kg
A probable explanation for these differences was the lower level of supplementary feeding provided for high yielding autumn compared with winter calving cows over the first eight weeks of lactation. Over the past two years specific attention has been given to the provision of additional concentrate feeding to autumn calvers in order to obviate this limitation.

However, in the second year of the study, the dominant feature influencing the lactation yields of the autumn calvers (22 cows) was the lower peak yield of 28±1 kg and a slow rate of decline of 1.3±0.1% per week thereafter. Winter calvers on the other hand again peaked at 33±0.7 kg and declined at the expected rate of 2.1±0.1% per week and a probable explanation for this disparity has been found in the differences in weight gain and body condition between successive calvings. The autumn calving cows regained their post-partum weight by turn out and then made little further gain on summer grazing, which after July was affected by drought conditions. Thus at calving in the autumn of 1975, cows commencing their second and third lactations had gained on average only 23 and 2 kg respectively compared with their calving weight the previous year. Corresponding bodyweight changes for winter calving cows were gains of 34 and 19 kg, respectively. Over the 1975/76 lactation the autumn calving cows received more liberal concentrate feeding in relation to yield (0.30 kg conc/kg milk compared with 0.28 kg conc/kg milk) than in the previous lactation. In association with this, not only was rate of decline in milk yield slower, but liveweight gains increased. The cows were 6.5% heavier at the subsequent calving in autumn 1976 and peak yields were up to 30±0.8 kg.

Recording has been extended to include regular condition scoring of the cows at drying off, soon after calving, at service (or 8 weeks) and at pregnancy diagnosis (or 16 weeks after calving).

Feed intake

As a development of the previous investigation, estimates of the bulk feed intake of selected groups of cows have been made using general prediction equations such as those provided by Technical Bulletin 33. However, this approach is of limited precision and attention is also being directed to the use of electronic doors set in a tombstone feed-fence, as a means of monitoring the feed consumption of individual cows. The technique has so far been used with small groups of dry cows. It will be extended to monitoring the intake of selected lactating cows as soon as new buildings are available.

Efficiency of rebreeding

Complete breeding records are maintained and are used to identify limiting factors and potential problems, to provide guidance for further improvements in calving intervals and to demonstrate sound management control of this critical feature of herd performance. As well as regular observation of cows for oestrous, a 'teaser' bull is penned close to the cows during the breeding period as a stimulus to oestrous behaviour and an aid to its detection.

This investigation makes use of existing breeding records, to evaluate the effectiveness of heat identification (in terms of average interval from calving to first observed heat and average interval between observed heats) and the factors responsible for variation in conception rate. Pregnancy diagnosis per rectum is being supplemented by earlier diagnosis of the basis of progesterone levels in milk. The diagnosis of possible causes of infertility is being investigated by veterinarians in those 10 to 15% of cows that show delayed first heat, irregular oestrous cycles or return to service more than three times.

The reproductive performance of the herd over the past two years is shown below:

	1974/75	1975/76
Calving interval—days	385	381
Conception rate[1] to A.I. %		
1st insemination	56	54
2nd insemination	58	57
1st and 2nd combined	82	81

[1] Based on pregnancy diagnosis per rectum after 42 days.

Inter-relation of Langhill to on-farm development and extension

Techniques and management aids tested and refined at Langhill are being extended to commercial farms, in some cases with follow-up recording and in others in the form of direct advisory action. Performance at Langhill is also being compared with that recorded on a sample of commercial farms. In this respect twenty-five farms are being costed in a milik production systems investigation (Dodds, 1976).

Large herd management

Forty-eight parlour-milked herds in Angus, Perth and Fife are involved in an investigation of the relationship between husbandry and health, which focuses particularly on milking management, bulk milk cell count and mastitis control and also incorporates investigations of lameness and herd wastage (Bell et al., 1976).

Records and milk samples have been collected and assessments of milking management carried out over the past year and a half in the course or regular monthly visits by dairy husbandry advisers and support services from the Veterinary Investigation Laboratory.

The mean milk cell count for these herds over a 6-month winter period was 452,000 cells/ml. Eight of the 48 herds had counts below 300,000 cells/ml. Over this winter period on average 16% cows and 2% of heifers were treated for mastitis. Regular teat dipping, which was undertaken in 25 of the herds, emerged as the principal feature associated with low cell counts. This was especially evident in herds housed in courts, where those teat dipping had a mean cell count half as high as those not teat dipping (340,000 v 700,000 cells/ml). The majority of herds are using dry cow therapy with antibiotics as a regular routine.

Appraisal of information from the first winter period has been used to draw up a profile for each herd of milking management, variation in milk cell count and apparent incidence of mastitis. This is now being used as the basis for specific advice to each co-operator on a confidential basis, with in selected cases the involvement of the farmers' veterinary practitioner in a collaborative advisory action.

The incidence of **lameness** has been assessed in thirty of these herds. The majority occurred in winter in cubicle housed herds where the incidence rose to 10%. Friesians showed a higher incidence of lameness than Ayrshires and six Friesian herds housed in cubicles had an incidence of over 20% (Bell and Miller, 1976).

The investigation of the **causes of culling** in these herds has highlighted the fact that in an overall culling rate of 24%, one-third of culls (8% of all cows) were disposed of because of failure to rebreed (Brocklehurst, Bell and Miller, 1976). This rebreeding problem emerges as a priority area for further attention in this project. The procedures that are being used at Langhill are being adapted for on-farm development studies in this area and the husbandry approach to improve regular rebreeding has been summarised in an advisory publication (Prescott and Robertson, 1976).

Breeding and feeding for higher yields

The effective use of A.I. and selection of cows for heifer breeding on the basis of "indexing" are incorporated into our advisory activity.

There is also considerable interest, and not a little concern, about the possible role of Canadian Holsteins and their crosses both in milk and beef production. A few large herds contain large numbers of high yielding Holsteins, but the substantially lower return from the sale of their calves for beef production outweighs much of the milk yield advantage of the cows. The investigations conducted by the MMB and MLC into the beefing qualities of the Holstein, suggest that they are only marginally inferior to British Friesians in carcass gain and muscle : bone ratio and not very different in fat cover. However, because of their leggy conformation they are generally unacceptable as carcasses for conventional meat trading at the present time. It is, however, in many respects not unlike the position of the Friesian, twenty years ago. An economic way of raising Holstein-crosses to heavy weights may be developed over the next few years and the beef market is changing its requirements and methods sufficiently for there to be a future prospect of them becoming more acceptable. However, the extent to which Holsteins will maintain a yield advantage in the face of the steady improvement in the British Friesian is open to question.

Feeding for higher yields is currently the main theme of our advisory programme (Lewis and Prescott, 1975; Prescott and Lewis, 1976). The influence of feeding in early lactation on the production of a high total lactation yield is emphasised and the importance of high quality silage in reducing winter feed costs and sustaining high yields in mid-lactation is exemplified. Attention is also drawn to the importance of restoring body condition in late lactation and ensuring this is maintained during the dry period so that cows calve in fit condition with a potential for a high peak yield.

As well as concern with the modification of self-feed silage systems to permit trough feeding there is also considerable interest in the use of selective automatic concentrate feeders for dispensing extra concentrates to high yielding cows outside the parlour and also in 'complete diet' feeding systems. Contact is being maintained with a number of herds that have adopted these innovations and it is clear that the acceptability and accessability of silage has a critical influence on the success of selective automatic concentrate feeding which can otherwise give rise to digestive upsets and problems of low butterfat. Complete diet feeding, while attractive, is expensive in terms of capital equipment and only feasible in certain building layouts.

Herd management control

Dairy farmers are being advised to undertake regular checks on both milk production and cow condition as an aid to better management. In particular it is recommended that the following features are observed :

(i) the rise to peak and level of peak yields of their cows;

(ii) the rate of decline of yields of an 'INDICATOR' group of cows, week by week from the 10th week of lactation onwards; expecting that yields will not fall faster than 2% per week;

(iii) the body condition score of cows, at strategic stages of the production cycle.

Condition scoring

The dairy cows at Langhill are condition scored according to the technique developed on beef cows which involves handling the cow to assess fat cover over the spinous processes on either side of the backbone in the loin region (Lowman, Scott and Somerville, 1976).

Score 1 The individual spinous processes are sharp to touch and easily distinguished.

Score 2 The individual processes are distinguishable, but feel rounded rather than sharp.

Score 3 The individual bones can only be felt with very firm pressure and are well covered with fat.

This scoring method can readily and consistently be applied by the cowman whenever there is an opportunity to handle cows. It is most useful if the checks on condition are made part of a regular routine :

(i) when cows are dried off

(ii) when they calve

(iii) about 8 weeks after calving (or at first service)

(iv) again at about 16 weeks after calving (or at pregnancy testing).

Scores should be noted down and a check back through such records will show how cows are changing in condition which can be used as a guide to feeding. In general if cows in mid-lactation fall lower in condition than a score of 2 their feeding and management should be reviewed and improved and in late lactation and at calving the aim should be to have them at a condition score of at least 3.

The returns from high yielding cows and the potential loss that can occur if they are mismanaged or underfed around calving fully justifies the extra attention that checking of this kind involves.

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Co-operative Support in Dairy Farm Development

T. LYONS

Kerry Co-Operative Creameries

In the period 1960-1975 there have been revolutionary changes in dairy farm production methods, in creamery structure, product range, processing capacity and in marketing strategy. Farmers, through their Co-ops., are basically in control of the industry. Furthermore, a half dozen major Co-ops. handle 70% of the manufacturing milk. Individual Co-op. policy can therefore affect many farmers.

Dairy Co-ops. are primarily concerned with the purchase of all milk produced by suppliers/shareholders, its efficient assembly and the production of a diversified range of quality dairy products, the objective being to obtain the best return in the market place for each gallon of milk purchased.

However, since milk is their prime source of revenue, it is logical that policies to promote development and to service the requirements of dairy farmers should be pursued by individual Co-ops. Irish dairy Co-ops. are very often ranked on the milk price paid to the farmer and profits earned, with no account being taken of the range and type of services and inputs provided to farmers.

Since the average milk production per farm is low in Ireland, milk price alone will not solve the income problems of many of our farmers. The opportunities for increasing dairy farm income in the future depends on the ability of all concerned to improve low yields. It now appears that the agricultural technology, land resources, genetic potential and financial awards are all available to accomplish this task.

This paper will attempt to analyse the problems affecting dairy farmers in Kerry and outline briefly the policies of Kerry Co-op. Creameries in helping to farm productively.

Dairy farming in Kerry

Kerry has been traditionally a dairying county and now produces over 11% of Irish milk output. Soil resources are variable and have a limited use range; for example 94% of the "arable" area is under grass

Because of soil restrictions and climatic conditions farmers have only limited opportunities for non-grassland enterprises. Dairying is therefore the chief farm enterprise.

There have been major changes in milk processing and creamery structure in Kerry since 1972. In 1970, 90% of the skim milk in the country was fed to livestock. Now a single organisation purchases all milk for processing at two centres in the county.

Following its formation in 1974, Kerry Co-op. Creameries set up as a priority an Agricultural Division whose role included the provision of worth while services. Initially it was decided to examine the structure of dairy farming in the area as a basis for :

1. Company policy to promote, aid and service development.
2. Establishing an agreed operating relationship with Agricultural and Veterinary agencies.

The main conclusions from this study were :

1. Herd sizes, milk yields and consequently milk sales were low; the potential for substantial expansion existed.
2. Management facilities for expansion of herds were inadequate and considerable re-organisation of farm yards and farms was required.
3. Expansion in silage conservation was necessary in order to improve winter feed supply and quality, bearing in mind the climatic conditions in the county for hay making.
4. The incidence of mastitis in herds was high and was obviously affecting milk yields.
5. Calf rearing methods could usefully be changed.

Milk yield per cow

An examination of the pattern of milk delivery to Kerry Co-op. indicated that calving date has a large effect on milk yield. Less than 8% of total milk supply is delivered before April 1st. From our A.I. records we know that nearly 40% of cows calve down after this date.

Role of Co-ops. in farm development

The Co-operative can stimulate development in a number of ways :

1. By assemblying and analysing information on dairy farm efficiency on a local basis in order to identify current performance, problems and constraints.
2. By bringing this information to the attention of farmer representatives, advisory, farm development and veterinary services.
3. Deciding on an agreed action programme with defined responsibilities and commitments by each sector.
4. Providing services and inputs as required to service development.
5. Structuring milk pricing policies to stimulate farmer interest and action in a given direction.
6. Setting of targets for milk output in each area.

A summary of the main policies and services currently in operation is presented in Table 1.

Calving date

It is to the farmers' advantage now to calve down a creamery herd earlier in spring. But the advantage is eroded in the absence of high quality silage, early grass and liberal meal feeding practice. Many Co-op. Societies are now operating an early calving scheme so as to encourage

Table 1

Influencing Factor	Objective	Policy and Service
1. Calving date	Jan./Feb. calving	Early calving bonus 5p per gal.—January 3p per gal.—February $1\frac{1}{2}$p per gal.—March
2. Nutrition and management	Better feeding	By making high quality feeds available By promoting grass productivity and more silage
3. Animal health	Reduce level of mastitis, eradicate brucellosis	By providing cell counting service with veterinarians By providing milking machine testing service By operating pre intensive brucellosis scheme with Dept. of Agriculture By paying bonus of $\frac{1}{2}$p per gal. for premium milk Additional bonus for mastitis-free milk
4. Breeding	Improve genetic merit of cows	By purchasing and testing best quality dairy bulls for A.I. use
5. High usage of whole milk for calf rearing	Promote alternative system of calf rearing	By making available high quality milk replacer and calf feeds Demonstration of early weaning system with advisers
6. Farm development and equipment	Improve farmyard facilities and layout	Operate a farm building ser vice in conjunction with advisory service and private contractors Provide fencing service through private contractors Provide milking and cooling equipment
7. Milk quality	Reduce percentage of poor grade milk	1. Operate a milk quality incentive scheme 2. Provide lab. facilities for investigation Advisory service involvement
8.	To provide farmers with management information	Promote computerised service with Agricultural Institute

earlier spring milk and while this may not solve the high peak for the processor it will nevertheless increase throughput in the earlier part of the year. In Kerry over the past couple of seasons the percentage increase in early spring milik has been twice that of the annual increase. The vital question is whether the industry should concentrate on compact early spring calving with its resultant peaks and troughs or whether a greater spread of calving should be encouraged.

Farm building and fencing services

With the advent of the Farm Modernisation Scheme there is much planned development activity taking place on farms. The objective of our Farm Buildings Scheme is to ensure that farmers who have development plans can complete their work as specified in the plan. The scheme is operated with the minimum of supervisory and administrative staff using private contractors with signed agreements with the farmer. The actual planning is caried out by the Advisory Service. Our Farm Building Service will then prepare detailed layout plans, costings and arrange for erection. The Scheme has been widely practised and to date over 400 separate building projects have been completed.

Animal breeding

An A.I. service in Kerry is now under the control of Kerry Co-op. Creameries and is operated under licence from the Department of Agriculture. It is now based completely on a proven stud. A.I. is of very great importance in the long term improvement of milk yields. In practice dairy herd management and feeding and not genetics are responsible for low milk yields.

Animal health

The control of mastitis and the elimination of brucellosis are two urgent tasks facing dairy farmers. In addition to providing a cell counting service and operating the national Pre-intensive Brucellosis Scheme in conjunction with the Department of Agriculture and veterinary practitioners, Kerry Co-op. has added a financial incentive for milk delivered which is considered to be free of these two diseases.

Changes in recent years

The changes in structure are somewhat similar to national changes. An interesting feature has been the change in milk yield per cow in the 1974 to 1976 period (Table 2).

Improvement in cell counts

The introduction of a bonus payment for milk of low cell counts has created a greater awareness of mastitis as a disease and a demand for veterinary and other advice on control measures. Since the introduction of the scheme there has been a considerable improvement in the quantity of low cell count milk delivered (Table 3).

Table 2

Changes in dairying structure in Kerry 1960-1976

Year	Milk delivery (m. gals.)	No. of milk suppliers	Average yield per cow	Average herd size
1960	42.5	—	—	—
1970	61.0	10,250	490	12.1
1974	66.0	8,800	496	15.1
1975	71.0	8,700	538	15.2
1976	78.0	8,500	570	16.1
1977 projected	84.0	8,400	580	17.2
% change 1960 to '76	+83.5	−17	+17	+33

Table 3

Mean cell count	1974	1975	1976
< 500,000 cells	31.75%	32.8%	44%
1,000,000 +	26.5%	22.3%	13%

Dairy Produce Prices and Market Prospects

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We are producers of a product which has tended towards world over-supply in the past decade. To be more precise, supply has exceeded the demand which exists at economic price levels—the result being a fall in the price which consumers need to pay in order to obtain supplies. This is a simplified statement of a very complex issue and needs to be amplified and put in context.

World position

World milk production tends, as a consequence of political action, to be divided into a number of "blocs" which are self contained in varying degrees. Table 1 shows the percentage of world milk production which arises in each of these blocs and a crude estimate of the proportion of world milk supplies which are surplus to the domestic requirement of the individual bloc. World surplus amounts to about 6% of total production. Five sixths of the surplus arises in the E.E.C. and Australasia taken together. The other surplus producing areas are Western Europe (other than E.E.C.) and North America.

Table 1

Estimated sources of world milk production

	% of world milk production	Milk surplus to domestic requirements % of world production
E.E.C.	25%	2.5%
Other W. Europe	5%	0.5%
Eastern Europe	30%	—
N. America	16%	0.5%
Australasia	3%	2.5%
Others	21%	—
Total	100%	6.0%

Reaction to this situation is along the expected lines. There have been stringent measures introduced in some of the surplus producing areas, namely Canada, Australia and non-E.E.C. countries such as Norway and Switzerland. Eastern Europe, which is usually roughly in balance and cannot afford the risk of a shortage because of lack of foreign currency to pay for imports, plans to increase production. Results so far are modest and output is more than usually dependent on weather conditions, especially in Russia. U.S.A. is roughly in balance. New Zealand is so heavily dependent on her dairy industry that she has no option but to press forward.

Alone among the major world blocs, the E.E.C. has not yet made a logical response to her position. The E.E.C. produces over 40% of the world's milk surplus and where the requirements of importing countries do not match the availability from exporting countries, the E.E.C. is able to claim only about 22% of the world net export trade (Table 2). Therefore, apart from Australasia, the E.E.C. is the bloc most severely out of equilibrium and clearly has an interest in redressing this imbalance by attention both to its own supply position and the world demand situation.

Table 2

Estimated sources of surplus milk and net balance of world trade

	Proportion of milk available for export	% of net world exports
E.E.C.	42%	+ 22%
Other W. Europe	8%	+ 13%
Eastern Europe	—	+ 3%
N. America	8%	− 7%
Australasia	42%	+ 62%
Others	—	− 93%
Total	100%	—

E.E.C. internal position

A study of the internal E.E.C. position also gives cause for concern. Consumption of liquid milk and butter is steadily downward (Tables 3 and 4), and although cheese consumption is increasing it in no way offsets the losses on liquid milk and butter. Net consumption is therefore downward.

Production, on the other hand, appears to be steadily increasing, with deliveries to dairies up 43% in the 15 years to 1975. It is probably true to say that the security of the intervention system, allied to the steady upward movement in guaranteed prices, has contributed to this increase.

This alliance of rising production and falling consumption, leading to higher stocks and export surpluses, is one which must concern us all. It is clearly in the interests of all who value the Common Agricultural Policy, and who benefit by it, to aid its preservation by ensuring that the financial burdens arsing from its operation do not lead to its downfall.

Table 3

Consumption per head of liquid milk in E.E.C. countries (kg per head)

Country	Whole (natural and standardised) 1965	1970	1974	1975
Germany	82.3	78.1	58.5	53.6
France	79.0	74.2	66.4	—
Italy	62.8	65.4	53.4	—
Netherlands	120.1	96.7	74.0	69.6
Belgium	86.9	81.0	61.3	57.4
Luxembourg	97.4	92.4	87.0	85.0
United Kingdom	146.5	141.1	143.3	146.1
Denmark	131.8	106.1	73.5	77.1
Irish Republic	217.2	212.5	207.4	206.0

Table 4

Consumption per head of butter and cheese in E.E.C. countries (kg per head)

	Butter					Cheese				
Country	1965	1970	1973	1974	1975	1965	1970	1973	1974	1975
Germany	8.5	8.6	7.3	7.1	6.8	8.0	10.0	11.1	11.4	11.8
France	8.8	9.0	8.8	9.3	—	11.9	14.0	14.8	14,7	—
Italy	1.9	1.9	2.2	2.5	—	8.6	10.6	11.4	11.3	—
Netherlands	4.4	2.9	2.3	2.6	2.6	8.1	8.5	9.8	10.4	10.6
Belgium	8.6	9.5	9.1	8.8	9.5	6.3	7.8	9.1	9.2	9.6
Luxembourg	10.0	8.1	7.5	7.4	7.5	—	—	11.6	9.2	10.6
United Kingdom	8.8	8.8	7.6	8.5	8.2	4.6	5.4	5.8	5.9	6.3
Denmark	10.1	9.1	8.1	8.2	7.9	8.9	9.4	9.3	10.0	9.6
Irish Republic	15.1	12.4	12.5	12.7	11.8	1.7	2.0	2.6	3.0	2.0

Sources: IDF; National Statistics.

Ireland—analysis and projection

(1) Production

Production is steadily rising. The security of the intervention system, allied to the steady upward movement in prices, has assisted this trend. Projections of possible Irish milk output in the years 1976 to '82 together with the possible utilisation pattern are shown in Table 5. It is, however, necessary to qualify this projection. It is based on an annual increase in deliveries to dairies of approximately 8%; this is an arbitrary figure used simply to give an idea of the order of magnitude of the problems which may arise from such an increase.

Table 5

Projection of Irish milk production and utilisation ('000 tonnes)

	1976	1977	1978	1979	1980	1981	1982	1982 Index 1976 = 100
Total production	4830	5150	5450	5760	6130	6600	5920	123
Deliveries to dairies	3572	3885	4175	4470	4820	5270	5570	156
Liquid consumption	380	375	375	370	370	370	370	97
Milk for manufacturing	3192	3510	3800	4100	4450	4900	5200	163
of which								
Butter/SMP	2380 (75%)	2630	2850	3075	3340	3675	3900	162
Cheese	540 (17%)	600	650	700	750	829	880	163
Others	272	280	300	325	360	396	420	154

Note

(i) I have assumed that utilisation of milk available for manufacturing will remain proportionally the same as it has been in 1976. This assumption is purely for the purpose of exposition of the situation which could arise as a result.

(ii) All 1976 figures are estimates. (iii) 1 tonne = 213 gallons.

Table 6

Projection of Irish output of butter, cheese and SMP and division between domestic consumption and export ('000 tons)

	1976	1977	1978	1979	1980	1981	1982	1982 Index (1976 = 100)
Output								
Butter	96	108	117	127	137	150	160	163
Cheese	50	56	60	65	70	77	81	163
Skimmed milk powder	190	210	225	245	265	300	310	163
Domestic consumption								
Butter	36	34	34	35	36	37	38	106
Cheese	7	8	9	10	10	11	11	157
Skimmed milk powder	—	—	—	—	—	—	—	—
Quantities available for export								
Butter	60	74	83	92	101	113	122	203
Cheese	43	48	51	55	60	66	70	163
Skimmed milk powder	190	210	225	245	265	300	310	163

Note: All 1976 figures are estimated.

For liquid consumption, I have assumed a slight decline over the period, and in regard to milk for manufacturing, I have assumed a production pattern based on the 1976 figures which showed that 75% of milk went into butter production, with the resultant skim being used chiefly for skimmed milk powder and to a lesser extent casein.

Cheese absorbed 17% of manufacturing milk in 1976. Again, the assumption o the continuation of this pattern is arbitrary although past experience has shown the difficulty of getting below the 75% mark as far as butter/skim products are concerned.

The result of this projection is that milk for manufacturing would increase by 63% in the six year period 1976-82 (Table 6).

Table 6 gives estimates of the amounts of butter, cheese and skim powder available for export. The result of this is that in the six year period 1976-82, quantities of products available for export would INCREASE by the following amounts:

	1976 availability for export	Projected 1982 availability for export	Increase 1976-82
Butter	66,000 tons	126,000 tons	60,000 tons
Cheese	42,000	70,000	28,000
SMP	190,000	310,000	120,000

(2) **Markets**

Table 7 gives a broad outline of present markets. The following sectors which between them accounted for 85% of total market income in 1975 will now be discussed:

— Domestic Irish market for liquid milk and butter (27%)
— U.K. market for butter and cheese (30%)
— Skimmed milk powder exports (18%)

Table 7

Utilisation of Irish milk production by sales value (1975) £ million

	Domestic market	U.K.	Other export	Total	% of total
Liquid milk	51	—	—	51	16
Butter	35	52	6	93	28
Cheese	8	47	5	60	19
SMP	1	7	60	68	22
Others	6	34	12	52	16
	£101m	£140m	£83m	£324m	
% of total	31	43	26		

(a) **Domestic market**

The Irish market is the one which is most secure and least vulnerable to foreign competition. Liquid milk consumption per capita is already very high but is showing some decline (Table 3). Butter consumption is showing a similar trend (Table 4). Cheese consumption is showing an increasing trend but does very little to offset the losses in the liquid milk and butter sectors. Therefore, the overall picture is that total milk and dairy produce consumption in Ireland is in steady decline. This is a serious matter for the dairy industry; the concern here is not with market share but with the preservation and development of overall market size and it is clearly in the interests of the industry, therefore, to support and sponsor all promotional and marketing efforts to persuade consumers to use more milk in its various forms. It must not be overlooked, however, that products should be available at prices which people can afford to pay and it seems sensible to bear in mind the position and possible reaction of the consumer whenever price measures are being contemplated.

(b) **U.K. market**

The U.K. market is of paramount importance to the Irish dairy industry. Ireland has a comparative advantage over all other E.E.C. countries (except the U.K. itself) because of :

- Physical proximity and therefore lower transport costs;
- Acceptability of types and quality of product;
- Lengthy establishment in the market and the substantial marketing investments made over the past 10/15 years.

It is clearly a top priority market. Given the above advantages, if Ireland cannot win in the U.K. market, her prospects in other markets must be less favourable. Therefore, trends in the U.K. dairy scene are worthy of the closest study and the main points are summarised below.

Butter and cheese prices are estimated to rise by 44% and 33% respectively (in real terms i.e. before allowing for inflation) over a five year period (see Table 6). This will inevitably be accompanied by falling consumption, especially butter (where consumption drops may be estimated variously from 12-25% over the next five years) and, to a lesser extent, liquid milk. Cheese on the other hand has traditionally been resilient in the face of price rises. The summary position is that consumption of milk products as a whole is expected to drop by 13% over the next five years.

Increased milk production is now official U.K. Government policy and, from the U.K. point of view, makes sound economic sense. One important factor is that since the liquid sector is expected to decline, all additional milk produced will be available for manufacture and therefore a relatively inocuous annual production increase of say 3% could, in fact, mean an increase in output of manufactured products of 10%. Table 8 sets out some projections of possible U.K. production levels in the coming years. It shows that total U.K. milk production may increase by 15% over the next six years, that liquid milk consumption may decline by 5% and that milk available for manufacture may consequently increase by 44%.

Table 8

Utilisation of milk in the United Kingdom

	1975/76 Actual		1976/77 Forecast		1981/82 Projected	
	Million litres milk	product Tonnes	Million litres milk	Tonnes product	Million litres milk	Tonnes Product
Sales through milk marketing schemes	13,389		13,650		15,430	
Liquid sale	7,875		7,670		7,500	
Manufacture of which	5,514		5,890		7,930	
Butter	1,499	66,000	1,930	84,000	3,630	157,000
Cheese	2,226	222,000	2,220	221,000	2,610	260,000
Cream	989		980		960	
Other	800		760		730	
Skimmed milk powder		138,000		160,000		310,000

Notes: Assume all skimmed milk is dried. The figures of product includes farmhouse production.

The British economy has been in recession for four years and seems likely to remain so at least for a further three. One of the consequences of this is the phenomenon of "trading-down". Price becomes of paramount importance to the consumer and he reacts against paying extra for premium brands or expensive packaging.

In a shrinking market with rising domestic production, the continued presence of New Zealand produce in guaranteed quantities and at prices which are contrived for the sale of those guaranteed quantities, becomes more difficult.

The combined operation of all these factors is already leading to tough situations especially in the butter and cheese markets. In Tables 9 and 10 I have attempted to demonstrate the potential market situations.

Ireland will be at a comparative disadvantage to the U.K. and New Zealand; to the U.K. because, prices being equal, there will be a tendency towards consumer preferences for the domestic product especially in the case of cheese; to New Zealand because of "guaranteed" stated quantities of produce in the market. There will be an intensely competitive situation among the E.E.C. partners, for a shrinking proportion of a shrinking market. On butter, for instance, we could find that countries such as Denmark, Netherlands, France, Germany and Ireland, who have recently sold between them up to 300,000 tons annually of butter in the U.K., will now be competing for a market sector potentially as low as 83,000 tons.

In cheese, principally Cheddar cheese, Ireland has, apart from U.K. production and the guaranteed New Zealand quantities an advantage over the other E.E.C. countries in that the quality of Irish cheese is more

Table 9

Projected U.K. demand/supply situation for butter: comparison of U.K. market size with quantities available for export from Ireland ('000 tons)

	1975	1976	1977	1978	1979	1980	1981	1982
Est. total U.K. consumption	519	410	359	336	334	333	330	330
Absorbed by U.K production & N.Z. imports (see Table 8)	173	220	228	230	240	250	?	?
Balance to be filled by all other E.E.C. imports	346	190	131	106	94	83	?	?
Quantities available for export from Ireland (see Table 6)	52	66	77	86	95	104	117	126
Irish quantities : as % of total market	10	16	21	26	28	31	35	38
% of market share available after U.K. & N.Z.	15	35	59	81	101	125	?	?

Table 10

Projected U.K. demand/supply situation for cheese: comparison of U.K. market size with quantities available for export from Ireland ('000 tons)

	1975	1976	1977	1978	1979	1980	1981	1982
Est. total U.K. consumption	350	324	329	330	335	340	345	350
Absorbed by U.K. production and N.Z. imports	252	251	243	236	244	252	260	270
Balance to be filled by all other importers	98	83	86	94	91	88	85	80
Quantities available for export from Ireland	52	42	47	51	55	60	66	70
Irish quantities : as % of total market	15	12	14	15	16	18	19	20
% market share available after U.K. and N.Z.	53	51	55	54	60	68	78	87

acceptable to the U.K. market. Nevertheless, we could again find a group of countries (Ireland, Denmark, France, Germany and Holland) who recently have shipped as much as 110,000 tons annually to U.K., now competing for a market sector of 80,000 tons.

The inevitable consequence of this intense competition in butter and cheese markets will be lower price returns.

(c) **Skimmed milk powder exports**

The importance to Ireland of skimmed milk powder exports is demonstrated by the value of exports in 1975. It is particularly important to preserve alternatives to intervention sales. In so doing, over the past three years, Ireland has performed an important service not only to Irish producers but to all E.E.C. producers. Nevertheless, the best efforts in this respect will be hampered by chronic imbalances in world supply and demand which now manifests themselves in world prices around $350 per ton for a product which costs the E.E.C. up to $1,200 per ton to produce. We clearly have an interest, therefore, in the restoration of world equilibrium in this commodity.

(3) **Prices**

From the foregoing analysis, I consider it unlikely that market buoyancy can be expected to contribute positively to the development of prices over the next 3/5 years. If anything, the reverse is true. I have already pointed out that U.K. market returns, especially for butter may turn out to be less than intervention equivalent.

However, there are three other possible sources of price increase available to Irish producers :

(i) Two remaining transitional stages (1.4.77 and 1.1.78) which would both be quite small, would refer to butter only and would amount to about 2% increase.

(ii) The size of Annual Review increases is anybody's guess but given the growing recognition of structural imbalance and the high stock situation it seems possible that the increases will be low rather than high, say 3-4% annually.

(iii) There still remains approximately 11% to be gained for Irish producers by Green Pound devaluation.

It must also be considered that market prices do not and will not necessarily move with intervention prices and that there will be unavoidable increases in transport, labour and selling costs.

Quite clearly, all economies must be sought in order to pass back to producers a maximum proportion of what will be, after all, relatively modest increases.

Producer prices in Ireland in the period 1972-5 increased by 90% (in sterling terms). It is perfectly clear that unit price increases of that magnitude are behind us, and it would be wise to concentrate on the expansion of production as a means of raising farm income in the coming years. This would be also a good defence against the forthcoming competitive situation. It is worth noting that the New Zealand system of high yield and herd sizes/low costs and prices has enabled her to win a disproportionately high share of world trade and to retain it in recent years against all the odds.

(4) Summary—analysis and projections

Table 6 showed the product output arising from milk production and indicated an annual increase of about 8% in volume. I then assumed a domestic market showing a slight reduction in liquid consumption, an initial reduction and then a recovery in butter consumption and a steadily rising cheese consumption. Substracting one from the other gives an idea of the order of magnitude of products available for export. These figures are quite substantial and show that on a weighted milk-equivalent basis, the quantity of products available for export will almost double in the next six years.

For major export markets Table 9 summarises trends in U.K. consumption of butter, U.K. domestic production of butter and imports of New Zealand butter, together with the quantities of Irish butter available for export. The position is hardly encouraging. It shows that by 1980 total U.K. consumption may be 333,000 tons, U.K. domestic production and New Zealand's imports—250,000 tons, leaving a remaining market sector of 83,000 tons to be supplied by all other E.E.C. countries. In that year, Ireland alone may have 101,000 tons available for export. Apart from demonstrating the obvious difficulty of the U.K. market, these figures also emphasise the increasing importance of non-U.K. butter trade which has been built up in recent years.

Trends for cheese exports are projected on Table 10. The key factors are the exclusion of New Zealand cheese and the relative acceptability of the Irish product. By 1980 a total U.K. consumption of 340,000 tons is predicted with domestic production of 252,000 tons leaving a balance to be supplied by all other E.E.C. countries of 88,000. In that year, Ireland may have about 60,000 tons to export. Thus, we require 68% of the non-U.K. sector to fulfil our needs as opposed to 51% in 1976, not at all an impossible task.

The position on skimmed milk powder, in world markets, is practically impossible to quantify. There will be greatly increased quantities available for export and market expertise and customer contracts built up over the past 8-10 years will enable Ireland to perform better than most other exporting countries. However, whether such export sales will provide a return better than the alternative (intervention), or whether indeed intervention will continue to be an alternative, are outside our control, depending as they do on the world supply and demand situation and on policies and export subsidies emanating from Brussels.

Conclusions

The foregoing analysis suggests a number of courses of action—international policies, E.E.C. institutional, the market place and finally within our own industry.

1. International policies

The development of world markets, co-operation with developing countries and development of Food Aid programmes is a matter much more of politics than of economics. The successful sale of ever-growing quantities of skim powder on world markets depends, apart from the level of export subsidies from E.E.C., on the level of world demand, which in turn is greatly influenced by the development of the above mentioned programmes. Naturally Ireland's voice in international politics is not nearly so great as her need for action on this front, and the best course, therefore, may be to press the E.E.C. political machine into action. The development of world markets and co-operation with under developed countries together with the evolution of efficient channels for food aid programmes is a long and wearisome task but it is one which falls within the scope of the E.E.C.'s foreign policy department and this appears to be the best route for embarking on what is admittedly a long unhill struggle.

2. **Internal E.E.C. matters**

As major beneficiaries of the Common Agricultural Policy, Ireland has a strong interest in its preservation. This involves the correction of the structural imbalance which exists internally in E.E.C. and proposals which cover both the supply and demand sides of the E.E.C. milk business should be supported in our own interest.

On the demand side there are a number of areas of E.E.C. milk consumption which could benefit from promotion and advertising, for instance, liquid milk consumption in the European mainland, butter consumption in Holland and cheese consumption in the U.K. and Ireland.

On the supply side, there are various schemes proposed—reduction of cow numbers through disease eradication programmes, schemes for non-marketing premia and finally the reduction and eventual disappearance of imports from New Zealand.

Price could positively affect both supply and demand. It is in Ireland's particular interest that the balance of milk supplies be restored by stabilisation of E.E.C. intervention and target prices over a period long enough to discourage the marginal producers of milk in the Community. It is a fundamental principle of the Economic Community that goods should be produced where it is most economic to do so. Even a slight application of this old-fashioned principle should produce tangible, if peripherally painful results. Furthermore, the price restraint arising from this would positively aid consumption of our products. It is a subtle policy worthy of our deep consideration.

3. **Measures within Irish industry**

An analysis of Ireland's present position has shown that there are difficult times ahead. We should recognise that in the forthcoming competitive situation the country which is most efficient will be able to outstay the others when the pressure is on. This involves seeking increased efficiency of our industry at all levels—production, processing and marketing. On production the path to increased farm incomes will in the future lie more readily through increased output than through increased unit prices. The question of seasonality of production should also be studied and its effect on the costs of processing should be seriously examined. At processing level, we will require the maximum efficiency of management decision-making in regard to the allocation of milk to products (where that option exists) and regarding investment in further processing facilities to meet expected new levels of milk production. Furthermore, the efficiency of processing costs, together with the seasonality aspect, is a significant part of the final cost of our products and needs careful examination.

In marketing tasks, exporting is now a distinct skill in itself to take maximum advantage of the movement and the forecast movement of MCA's and ACA's. This has been of the utmost importance over the past three years and will continue to be so for the next year or two also. All the good work in other sectors can be dissipated by poor decisions in this.

More important, there is probably no substitute for hard selling. It is good to note that the four companies marketing Irish cheese in the U.K. are about to embark on a major joint promotional campaign financed by Irish cheese manufacturers. The logistics of distribution costs have to be continually scrutinised and sales promotional programmes examined for their effectiveness. Product and packaging improvements must be undertaken in the knowledge that it is a buyers' market for the foreseeable future.

4. **Financial policy**

Producers can be aided by devaluation of the Irish Green Pound rate down to its real level but accompanying this by appropriate increases in domestic food subsidies in order to protect consumption levels in Ireland.

5. **Markets**

We must preserve and develop our own market, not alone by promotional and advertising means but most importantly, by putting our products on the market at prices which the consumer can afford.

We have an interest in the preservation of the total size of the U.K. market and in the maintenance, in particular, of butter consumption at its present levels. The interest of the U.K. Government (lower consumer prices) and of the E.E.C. (high dairy products consumption) are identical. We should make every effort to reconcile these interests. Once consumption is lost, it will cost twice as much to win it back as it would have done to maintain it in the first place.

We have an interest in the exclusion of New Zealand butter and cheese from the U.K. market totally. We should seek to ensure that after 1978 New Zealand retains no rights in the cheese market and that its rights in the butter market be reduced to the lowest possible figure.

Retaining our share of a declining market will be hard work. We must recognise that while the U.K. economy is in recession what matters most is the price of our products on the counter, and all on-costs must be reviewed in this light. We can preserve and expand our market share only by aggressive selling and ruthless cost-cutting.

Production and Processing Developments in Dairying

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Irish dairy farmers have responded well to reasonable market assurance and to a reasonable price structure, in the form of a cumulative 20% more milk in just two years. A recent prediction by An Bord Bainne indicates that on the evidence available we will have nationally approximately 900 million gallons of manufacturing milk in 1981 (Table 1).

Table 1
Forecasts

Year	Cow numbers millions	Yield/cow gallons	Milk intake million galls.	Increase %
1975	1.042	600	624.7	+ 9.3
1976	1.060	636	674	+ 8.0
1977	1.100	655	720	+ 6.8
1978	1.148	675	775	+ 7.6
1979	1.180	690	814	+ 5.0
1980	1.210	700	847	+ 4.1
1981	1.241	710	881	+ 4.0

It is against this background that we must pose the question of where the industry is going and what shape it should take in the next five years and onwards. The figure for growth in production is based on performance in recent years, projected five years ahead. It is subject to certain risks that could alter the pattern dramatically, i.e. a limit on E.E.C. intervention such at the 50% imposed on beef sales would change the whole course of Irish dairy farming. Even a mild restriction of the present intervention system would have a profound effect. The fundamentals of the C.A.P. must be maintained intact. It is essential to the survival and development of the Irish dairy industry.

It is my belief that the projection referred to is realistic and it is certainly the best indicator available. It is a measurement against which plans in the next few years must be made. We must begin now in the knowledge that the 675 million gallons produced in 1976 caused a squeeze in many creameries in the peak weeks. We should have 730 million gallons coming up in 1977.

At the same time we do not need and cannot afford the upheaval of a full phase of nationwide plant building, especially if it is limited to butter and skim milk powder. More than ever we need planned rational expansion.

At this stage I wish to make three points :

1. Production and processing facilities are now near enough matched.
2. More investment will be needed in the industry **which must be paid for from the gallon of milk.**
3. We must not waste scarce and costly resources in unnecessary duplication of plant or effort.

Since the emergence of large scale amalgamation Co-ops. there has been pressure to pay out the last penny for milk. Perhaps there was need for some pressure to pave the way for a good rationalization programme as a second phase to the change to bigger creamery organisations. Now the time has come perhaps to lift the pressure, to take the emphasis off the short term and to think of the comparatively long term planning which the dairy industry needs.

It is not very difficult or very clever to produce butter and skim milk powder without considering all the other possibilities. In 1973 we put 65% of our milk into those products. In 1976, and not without reason, that figure rose to 75%. If 900 million gallons are produced without doing something serious about our product mix, then we are clearly moving to a ridiculous dominance of two products whose future is inseparable for intervention buying.

At a recent Co-op. dairy convention in the U.S. I was very interested to hear that the U.S. now has approximately 40% of the 1963 level of skim milk powder production. The attitude to declining butter consumption appears amazingly casual. It is looked upon as a by-product of skim milk powder and the general approach is to restrict its production according to the requirements of a declining skim milk powder market. That is a surprising turnabout.

The apparent change in attitude in the U.S. is no more radical than that in the Irish dairy industry during the same period. We have moved from an industry of hundreds of small creameries returning skim to a rationalised one. Six societies now handle 60% of the milk and no skim return. These facts indicate the rate of change in the industry and we must not be unduly worried about change.

Also, in the U.S. added emphasis has been given to the role of many of the products, in particular to cheese. I believe that we must do likewise, not in the light of comparative returns this year but in the long term. To date there has been more than adequate capacity for cheddar cheese (this does not mean that we may have additional capacity). In my view one or two good factories for the manufacture of Gouda, Emmenthal and Gruyere, and possibly other types are needed. But we don't need six Gouda factories. Plants to produce other specialised products are required, but not too many.

The problem is that the right factory for tomorrow may have to struggle a little today. Who is to have the prospect of them, even if the good prospect contains an element of early risk ? The question must be answered by farmers. The shareholders and milk producers of Irish Co-op creameries will have to declare their intent and give their support to rational planning for a long term product mix. It is not the task for Co-op. management, nor indeed for any one Co-op., although I believe much can be achieved by co-operation between neighbouring Co-ops. It is no easy or simple task and it requires a national blueprint.

Cheese production is the major bright spot in the dairy industry. World consumption is increasing annually. It is estimated that cheese production will use 40% of total milk production in 1984. Traditionally cheese trading has taken place between developed nations and this is likely to continue for some time, but in a modified way.

Improving the product range should open up some prospects in the European market for European type cheeses. In the Third World chronic hunger and poverty exists. It helps very little to give milk powder to people who have inadequate facilities to use it properly. Would it be easier to offer such people cheese in a suitable form and help them to appreciate nourishing qualities? I am no expert on the Third World, but it would appear sensible in time to try such an approach, despite the storage, freight and climatic problems of these countries.

The industry must find out through practical product development and market research what is required and where requirements can be changed. With the support of the industry, I believe that the responsibility for this work can be placed in the hands of a body such as An Bord Bainne. It may be necessary to provide better financial and technical assistance in certain market areas where obvious potential exists.

From a processing point of view, I wish to point out what is required from producers:

1. There has been substantially increased production in the past two years. It will best serve the interests of the industry and nation to maintain this trend. Our future lies in continued efficient expansion with more and better use of grass and obviously with improved farm incomes.
2. The industry needs high quality raw material, both compositional and bacteriological. High quality products are essential at any time, but never more essential than in times of surplus. We are in a period of scarcity, not moving towards one.
3. An improvement in the peak to valley ratio is required. The current one of 16 : 1 for manufacturing milk has very severe limitations of planning an extended product range.
4. There should be an understanding that some of the suggested developments would result in a movement away from intervention products and possibly for brief periods a slightly reduced milk price. We can be cavalier about the whole matter in that we produce only four per cent of E.E.C.'s milk total, so why be concerned? We must be concerned because milk production is important. We must avoid blatant abuse of the intervention mechanism because it is needed. If we act wrongly in the long term our vital industry is left in a very vulnerable situation.

In the light of these basic requirements, what can the industry at processing and marketing level offer farmers in future?

In return the industry can offer, and reasonably guarantee, such security as will allow farmers to engage in confident development of their dairy enterprises.

CATTLE TWINNING BY EGG TRANSFER

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Summary

Alternative methods of inducing superovulation in donor beef heifers were examined in an attempt to recover a high number of transferable eggs; the incidence of egg abnormalities increased substantially when recovery from the reproductive tract was delayed beyond day 4. Cattle eggs stored singly in 0.5 ml. capacity Cassou straws for 2-6 hours at 30°C developed satisfactority on transfer to the rabbit oviduct to assess viability. The effect of temperature on the outcome of transfer attempts in 28 recipient cattle was examined; embryo survival rate was higher when temperature was controlled at 30°C than when transfer was performed at ambient temperature (38% vs 8% survival). Five transfer calves were born to 12 cattle that each received a single egg one week after mating (44% twinning rate in cattle conceiving).

OESTRUS SYNCHRONISATION IN GILTS USING A SYNTHETIC PROGESTOGEN A-35957 AND INSEMINATED WITH FRESH OR PROZEN SEMEN

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Forty-eight gilts were divided into three groups matched on a weight basis. Group 1 received no compound and group 2 and 3 were fed the compound at a rate of 12.5 and 15 mg per pig per day as a premix for 19-21 days. As the gilts came into oestrus half of each group were inseminated with fresh and the other half frozen semen. Half of the gilts inseminated with fresh and frozen semen were operated on 2-4 days after the end of oestrus and ova recovered. These were examined for cleavage, presence of sperm and numbers of sperm in the zona pellicuda. The other half were slaughtered after 30 days if they failed to return to heat and the numbers of embryos and corpora lutea in the reproductive tract enumerated. Those returning to oestrus were re-inseminated. No significant difference between groups was found in the duration of oestrus which for group 1, 2 and 3 respectively were 54.9 ± 7.8, 58.9 ± 17.6, 53.6 ± 15 hours. The interval from the commencement of treatment to the onset of oestrus was significantly different between control and both treated groups, and was respectively 11.6 ± 7.8, 5.8 ± 1.2, 7.3 ± 5.3 days. There was no significant difference in the proportion of eggs cleaved in the treated and control groups but fresh semen yielded significantly more cleaved ova than frozen semen. The gilts inseminated with frozen semen from one of the boars yielded significantly more cleaved ova than those from three other boars. The proportion of gilts pregnant 30 days after insemination and average litter size in each of the three groups inseminated with fresh and frozen semen were respectively for Group 1 1/3,11; 0/3,0; Group 2 2/3, 11.5; 1/3, 7, and Group 3 1/2, 11; 0/3, 0. The proportion of gilts pregnant after repeat insemination with fresh or frozen semen and average litter size were respectively for gilts which had been previously operated upon 3/7, 10; 1/6, 10; and for those which returned to oestrus but were not operated on 2/5, 6; 2/5, 7.

OVULATION RATE AND CALVING RATE FOLLOWING THE USE OF PMSG OR Gn-RH IN POST-PARTUM BEEF COWS

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Output in the suckler herds could be increased by

(a) The use of artificial insemination to introduce sires of the Continental breeds (Charolais, Limousin, Simmental).

(b) By increasing the calf crop, both by increasing the number of cows in calf and by inducing twinning in a proportion of those.

One possible method of allowing artificial insemination and increasing the calf crop is the use of oestrus synchronization (induction) combined with follicular stimulation.

In this study both PMSG and Gn-RH (analogue Hoe 766) have been studied. In heifers PMSG doses of 0, 500, 750 and 1000 i.u. have resulted in ovulation rates of 0.9 ± 0.6; 2.2 ± 0.3; 3.1 ± 0.7; 5.3 ± 1.4. Following the dose of 500 i.u., 93% of the heifers had between one and four ovulations. Gn-RH was studied in heifers in doses ranging from 10 to 50 μg and while it effected a peak discharge of LH it reduced ovulation rate at most of the rates studied.

In post partum beef cows fertility was studied following dose rates of 0 and 750 i.u. of PMSG in conjunction with a progestagen sponge synchronization treatment. This resulted in an increase in calving rate from 53% to 72% with a 20% twinning rate in the PMSG treated group.

Further studies are continuing on the effect of varying PMSG dose rates at varying stages post partum.

Data on ovulation rate and timing, LH release and timing and fertility will be presented in relation to PMSG or Gn-RH treatments.

NON SURGICAL RECOVERY AND TRANSFER OF BOVINE EMBRYOS

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The success of bovine egg transfer as a breeding technique depends ultimately on being able to use a total non-surgical approach. The present communication deals with a study of factors affecting non-surgical recovery and transfer of bovine ova.

1. Non-surgical recovery

Method of recovery used was a 3-way (Foley type) plastic catheter. This catheter is passed through the cervix with the aid of a stillete which is withdrawn when the catheter is as far forward in the uterine horn as possible. Following cuff inflation, about 100-150 ml of recovery medium (physiological saline) is then introduced by gravity feed and finally recovered from the outlet lumen.

Recovery rate was higher with a 70 cm long catheter (53%) than with a 30 cm catheter (27%). Higher recovery rates were also obtained at days 7 + 8 (41%) than at days 5 + 6. Ovluation rate also had an affect on recovery rate with highest recovery (47%) from single ovulating animals and lowest (11%) from highly stimulated animals with an ovulation rate of > 11 (range 14 - 47). Parity status did not affect recovery rate.

At days 7 + 8 recovery rate with a 70 cm catheter was similar (41%) to surgical recovery (48%).

2. Non-surgical transfer

Single egg non-surgical transfers were carried out to either previously inseminated or non-inseminated recipients. Following transfer at days 8 and 9 to non-inseminated recipients (N = 10) an embryo survival of 60% was recorded. Following transfer to previously inseminated recipients a pregnancy rate of 55% was obtained with a twinning rate (of pregnant recipients) of 47%.

Higher embryo survival was recorded at days 8 + 9 than at 6 + 7 but the difference here was not significant.

Data on embryo recovery and survival following transfer will be presented in relation to the various factors affecting recovery and survival rates.

EVALUATION OF A SIMPLE METHOD FOR MEASURING PASTURE DRY MATTER PRODUCTION

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In most situations involving grazing animals total pasture output is an unknown quantity. Methods presently used to measure output are time consuming and not suitable for use on commercial farms or in advisory work. Hence, there is need for a rapid method for estimating dry matter production.

A simple instrument ('Grassmeter')* was used for this purpose. It comprised an aluminium base plate sliding on a vertical calibrated bar, the reading on the bar depending on the amount of grass beneath the plate. During the grazing season (March - November) readings were taken pre- and postgrazing on rotationally grazed permanent pastures (21-day rotation). The swards were perennial ryegrass dominant, stocked with dairy cows at the rate of one cow per 0.32 ha, and mean paddock size was 0.24 ha. Linear regression techniques were used to correlate the mean reading (15 observations) for each paddock with dry matter production estimates made by cutting five sample quadrats to ground level.

Month of year had a major effect on the correlation. For pre-grazing data the poorest relationship existed in mid-season (July, $r=0.41$, NS) but good correlations were obtained early (April, $r=0.94$, $p>0.01$) and late (August, $r = 0.80$, $p > 0.01$) in the growing season. The overall mean coefficient of variation for 'Grassmeter' readings within paddocks was 34%.

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* Grassmeter supplied by LCP Unit, MMB, Reading, England.

PASTURE PRODUCTION UNDER GRAZING

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Direct measurement of herbage production in grazing systems is more relevant in terms of animal production potential than extrapolation from cutting ('simulated grazing') experiments. Herbage production was estimated in three trials by the pre- and post-grazing difference method using a power-driven sheep shearing head for sampling.

In the first experiment herbage production averaged 9450, 8800 and 8150 kg DM/ha at stocking rates of 3.9, 5.5 and 7.1 cows/ha, respectively during April/August 1972-74 (150-day grazing period). In the second experiment total herbage production (March/November) was 12900 and 12700 kg DM/ha in 1975 and 1976, respectively at a stocking rate of 3.1 cows/ha. In the third experiment (March/November 1976) increasing stocking rate from 2.5 to 3.1 cows/ha decreased total herbage production from 13750 to 12150 kg DM/ha. In this series of experiments the coefficient of variation ranged from 12.5 to 28.1%.

ESTABLISHMENT OF NEW SWARDS BY DIRECT DRILLING

1. Effects of drilling two forms of fertilizer nitrogen

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Direct drilling as a method of crop establishment offers many advantages over the plough as a means of establishing a wide range of crops. If this technique can be perfected, then it would offer a worthwhile alternative to undersowing.

It has been suggested that direct drilled crops require higher N fertiliser inputs than conventionally grown crops to reach the same level of output. Many operators, using the Bettinson 3-D, drill nitrogen along with the seed when sowing grass. There is no experimental evidence to support this practice.

In the Autumn of 1975 two experiments were carried out on barley stubble using the Bettinson 3-D direct drill machine. The objective was to measure the effect of combine drilling two forms of fertilizer nitrogen on the establishment and subsequent yields of a number of Italian and perennial ryegrass varieties.

Experiment 1

In this experiment C.A.N., 26%N and Gold N, 32%N, a slow release nitrogen fertilizer, were drilled at two rates with the Italian varieties, Delecta and Lemtal. The fertilizers were drilled to supply equivalent amounts of N as follows:

33 kg/ha N as (a) 126 kg/ha of C.A.N.
(b) 102 kg/ha of Gold N and
66 kg/ha N as (a) 252 kg/ha of C.A.N.
(b) 204 kg/ha of Gold N

Experiment 2

In this experiment the lower rate of N, 33 kg/ha only, was drilled as in Expt. 1. The varieties used in this case were perennial ryegrass varieties Cropper, Spirit and Vigor. Plots drilled without nitrogen were used as controls.

For both experiments yield data were recorded in the spring and summer of 1976.

The results can be summarised as follows:

1. Drilling C.A.N. did not increase the yields over that of the control. At 252 kg/ha a slight reduction in yield was recorded.
2. Drilling the equivalent amount of N as "Gold N" did substantially increase the output in the following spring.
3. The earlier the variety in spring growth the higher the response to the slow release nitrogen.

THE ROLE OF SULPHUR IN LEGUME NITROGEN FIXATION AND CROP QUALITY

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Forage crops have a relatively high sulphur requirement. The element is known to be involved in nitrogen metabolism in the plant but its function in symbiotic nitrogen fixation has not been studied. This presentation describes the effect of added sulphur on nitrogen fixation by white (cult. Blanca) and red (cult. Hungaropoly) clovers in glasshouse experiments. The results show that sulphur is specifically important for symbiotic nitrogen fixation. When soil sulphur was low, addition of the element gave highly significant increases in plant yield, and several parameters of nitrogen fixation: nitrogen fixation per plant, nodule weight per plant and per unit weight of root and nitrogen fixation per unit weight of nodule. The sulphur content of various field grown forage crops, especially legumes, were examined. The levels observed reveal that red clover is very inefficient in extracting sulphur from soil. It is also evident that sulphur levels and nitrogen-sulphur ratios obtained in these crops, although adequate for plant growth, are seriously inadequate for maximum ruminant feeding value.

THE CHOICE OF ANIMAL TYPE IN CATTLE GRAZING EXPERIMENTS

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Grazing experiments are classified into those in which the animal is the object of study and those in which the animal is used to assess effects of treatments on grassland productivty. For the latter experiments it is shown that steers are statistically much more efficient than cows. Using statistics from a number of steer and cow grazing experiments it is shown that an experiment using steers could produce as precise an estimate of treatment effects on about one fifth of the area of an experiment using cows.

CAUSES OF PERINATAL MORTALITY IN PIGS

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A survey of perinatal mortality was undertaken in the Moorepark herd in 1976. Data were obtained relating to 3623 piglets born in 346 litters over a 10-month period. Post mortem examinations were carried out on 853 piglets representing 23.5% of all piglets born. Of these 325 were stillborn and examination showed death to have occurred pre-partum in 43 cases and intra-partum in 282 cases. A breakdown of the major causes of mortality shows the following :

Stillbirths	38.1%
Trauma	26.5%
Enteritis	12.7%
Starvation	6.1%
Inanition	5.2%
All other causes	11.4%

These data are being used as an aid in devising a programme of research into methods of reducing perinatal mortality.

THE EFFECT OF GROWTH RATE AND OF SEGREGATION FROM GILTS ON THE STRENGTH OF CARCASE ODOUR OF BOARS KEPT FOR MEAT PRODUCTION

N. WALKER and D. C. PATTERSON

In two experiments littermate pairs of boars were grown either quickly or slowly according to pre-determined weekly target live weights. In the first experiment subcutaneous fat from 40 pairs of boars was sampled by biopsy procedure at a mean overall live weight of 85.5 ± 0.2 kg at which point the boars were either 150 ± 0.8 or 186 ± 0.8 days of age. In the second experiment, 9 pairs of boars reached 121.0 ± 0.6 kg live weight at either 198 ± 0.9 or 267 ± 0.6 days of age and subcutaneous fat was sampled *pre* and *post mortem*. In a third investigation fat was sampled from commercially produced boars which had reached bacon weight in either less than 130 days or in more than 180 days. In all three experiments the fast growing boars had significantly stronger smelling fat than the slow growing boars.

Fat samples were stored at -18°C prior to odour evaluation and although storage time was confounded with growth rate treatment it appeared to have no effect on odour assessment.

Boars penned with gilts did not have depressed growth or feed conversion compared with boars penned in single sex groups. In one fattening house boars from mixed sex pens had significantly stronger smelling fat compared with boars from single sex pens although *post mortem* examination of ovaries revealed that none of the gilts in this part of the experiment had reached puberty. In the second fattening house, 3 out of the 90 gilts on experiment had ovulated, all from mixed sex groups but with no significant effect on the strength of fat odour of the boars.

METHOD OF FEEDING MILK TO CALVES

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The object of the work reported was to compare the effect of method of feeding (open pail versus nipple) milk replacer to young calves on (a) performance, (b) changes in blood glucose and (c) behaviour.

Performance was not significantly influenced by method of feeding. Changes in blood glucose following feeding tended to be greater in the nipple fed calves but in general differences failed to reach significance. The data on blood glucose changes, however, indicate that the condition of 'milk bloat' which occasionally develops when milk is fed from an open pail may be alleviated by reverting to nipple-feeding. Both water and concentrate intake tended to be higher in the open-pail fed calves than in the nipple fed calves.

PELVIC MEASUREMENTS AND DYSTOKIA IN COWS AND HEIFERS

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Pelvic measurements were made in two- and three-year old heifers and mature Friesian cows using a Litton hydraulic pelvic meter. Measurements were made on 144 two year old heifers, 95 three year old heifers and 19 mature cows. The pelvic cross sectional area was obtained by multiplying the height and width measurements, and this area was compared with the weight of the calf and ease of calving. The ease of calving was graded from one for unassisted calving, to four for very difficult calvings.

As calving difficulty increased there was a tendency for the pelvic area to decrease and calf weight to increase within each age category. Pelvic area in two year old heifers averaged 250, 237, 239 and 233 sq cms for animals with grade 1, 2, 3 and 4 calving difficulty categories respectively. Similar values for three year old heifers were 287, 286, 289 and 274 sq cms and for cows they were 310, 293, 294 and 289 sq cms. Calf weights increased from 34 to 39 kg in 2 year old heifers having grade 1 and grade 4 ease of calving respectively. In three year old heifers the weights were 37 and 42 kg and in cows 35 and 44 kg.

The relative size of the calf to the size of the maternal pelvis is thus a major factor in determining ease of calving. The cow will tend to regulate calf size according to her own size, but such factors as feeding system, sire and breed of sire probably reduce the effectiveness of this natural regulation.

FACTORS WHICH AFFECT CALF PRICE AT AUCTION MARKETS

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A survey was conducted in spring 1976 at six calf auction markets in the counties of Cork and Limerick. A total of 2,850 calves were recorded of which 50% were Friesian (Fr) males and 30% Fr females, 8.6% Hereford X Friesian (H X Fr) males and 9.7% H X Fr females. All other calves accounted for 11.7%. Beef breed crosses namely H X, H X Fr and Charolais X (Ch) had a significant price advantage over Friesian. The respective mean price for Fr, H X Fr, H X and Ch X males was £34, £48, £44 and £60. The mean liveweights for these crosses were 48, 50, 48 and 54 kg and for every kg increase or decrease in liveweight, the calf price changed by £2.10, £2.20, £1.70 and £2.50 respectively. Chest girth of calf (cm) had a significant effect on calf price (£) : 70-75 cm—£19.60 ± 7.90, 80-85 cm—£36.60 ± 10.80, 90-95 cm—£53.90 ± 6.90. Visual condition score was also an important determinant of price : poor—£20.90 ± 9.80, fair—£29.60 ± 10.10 and good—£4..30 ± 11.50. The assessment of calf age used was a poor determinant of price : 0 to 1 week—£25.50 ± 11.50, 2 to 3 weeks—£37.40 ± 11.80, 4 to 5 weeks —£43.00 ± 13.80. A price differential existed between auction marts and this was due to size of calf and to age of calf.

COMPARISON OF HOLSTEINS AND FRIESIANS FOR MILK AND BEEF PRODUCTION — PRELIMINARY RESULTS

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Twenty-one in calf Holstein heifers were imported from Canada in December 1974 in conjunction with Waterford Co-Op. A specially selected comparable group of 26 Pedigree and 25 Commercial in calf Irish Friesian heifers were assembled and the groups were managed as one herd in 1975 and 1976. In 1975 the herd was run on the Institute's newly reclaimed hill farm at Coolnakilla with no supplementation during the grazing season. In 1976 the herd was transferred to Waterford Co-Op's farm at Castlelyons; all animals received a supplementation of 8 lb concentrates/hd/day during the grazing season.

In 1975 the heifers calved at an average age of just under 2½ years at average weights of 950 lb, 990 lb and 938 lb for Holstein (H), Pedigree (P) and Commercial (C), respectively. The milk yields adjusted for date of calving, the fat % and protein % were 597 gal, 3.7%, 3.3%, 558 gal, 3.7%, 3.5% and 551 gal, 3.5% and 3.4% for H, P and C, respectively. This gave the Holsteins a 7% superiority in milk yield. The corresponding yields of milk, fat % and protein % for 1976 were 1093 gal, 3.8%, 3.4%, 963 gal, 3.85%, 3.6% and 899 gal, 3.7% and 3.5% for 14 H, 16 P and 19 C cows respectively. Thus the Holsteins yielded 13% more milk (10% more fat) than the Pedigree which in turn yielded 7% more milk than the Commercials.

A group of 30 twenty-month old Friesian steers—14 sired by Irish, 6 by Canadian Holstein and 10 by New Zealand bulls—were slaughtered in November 1976. One side of each carcass was broken down into commercial wholesale cuts. Compared with the Irish sired group, the Holsteins had significantly higher % tail of rump and % bone and lower % cube roll, front shin and leg width; New Zealand sired animals had significantly higher % bone and lower % rump and brisket. These preliminary results on relatively small numbers indicate that Irish sired cattle were better for beef merit.

PRELIMINARY STUDY ON THE GRAZING BEHAVIOUR OF DAIRY COWS

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Over 2 years grazing behaviour of cows within a herd composed of Holstein, Pedigree Friesian and Commercial Friesian was studied. During the 1975 grazing season the cows were located on a hill farm and were allowed to graze *ad libitum* in 2 ha ryegrass type pastures, except for two short periods, morning and evening for milking. The animals were moved to fresh pasture every 2 days. During 1976 the animals were on a lowland farm with permanent pasture (approx. 4 ha-plots). The animals were moved to fresh pasture when the supply of grass for grazing was exhausted.

During 1975 eating behaviour was recorded by radio telemetry which gave the times spent eating, ruminating and resting. In 1976 Vibracorders were used which recorded the times the animal's head was in a grazing position.

The average times spent eating, resting and ruminating (13 cows) in 1975 were 7.5 ± 0.9, 5.6 ± 2.1 and 10.9 ± 1.9 and grazing times in 1976 were Holstein (39), 9.5 ± 1.5 Pedigree Friesian (34), 8.7 ± 1.5 and Commercial Friesian (19), 9.4 ± 1.2. When the grazing time of the Holsteins was compared with either of the other breeds on a paired basis the means were, Holsteins 9.5; others 9.2 (N.S.).

Milk yield was not related to grazing time ($r = 0.22$ N.S.) in either year. Diurnal variation in eating throughout the average day was virtually identical for the three breeds. In general eating commenced with sunrise and finished shortly after sunset, in 1976 some "mid-night" grazing was noted. The eating times recorded by Vibracorder were about 100 min. greater than those by radio telemetry and this is in agreement with the literature on this topic.

Grazing time as measured by Vibracorders is only one aspect of the act of grazing and bite size, bite frequency and pasture quality have important roles.

FARM SIZE CONSTRAINTS ON STOCKING TARGETS ACHIEVABLE IN IRELAND

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Land quality varies greatly in Ireland. This is illustrated by the wide range of stocking rates achieved under experimental conditions at An Foras Taluntais Research Centres—from approximately 136 to 296 livestock units (L.U.) per 100 ha (55-120 L.U./100 acres). The amount of land required for an enterprise of a given size will therefore vary accordingly.

By taking into account the size distribution of holdings on each soil association in the country and the capacity of the soil for livestock production, this study quantifies the proportion of holdings technically capable of supporting four levels of stocking—20, 40, 60 and 100 L.U. The study shows that on a national scale, 63, 32, 19 and 7.5 per cent of holdings are capable of supporting these four levels of stocking respectively. These figures are compared with the existing herd size distribution pattern on farms. A moderate level of grassland management, which includes an input of 48 kg N/ha, is assumed.

Some of the results show, or instance, that in those areas which combine best size distribution of holding and quality of land 20 to 30 per cent of holdings are technically capable of achieving a target of 100 L.U. whereas in the poorer areas less than 2 per cent are capable of achieving this target. At a target of 40 L.U. Over 60 per cent of holdings are capable of achieving a target of over L.U. in the more favourable regions whereas the figure is less than 10 per cent in the most unfavourable regions.

Maps illustrating the spatial patterns established are included and the various implications of the study are discussed.

INCREASED LAMBING FREQUENCY

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To improve the efficiency of sheep production it is necessary to produce more lambs per ewe per year. To some extent this may be achieved genetically by introducing more prolific breeds or cross breeds. Increased prolificacy may also be achieved, with considerable advantage, by increasing lambing frequency. The gestation period of the sheep is 5 months but an average of only 0.8 to 1.6 lambs per ewe are born annually, depending on the breed of sheep and the environmental conditions, e.g. hill or lowland. The ewe is normally non-pregnant for seven of the 12 months each year.

In a preliminary trial to assess the effect of the two commercially available hormone preparations (60 mg MAP and 30 mg Cronolone) on fertility in the post-partum ewe, no significant difference was observed between the treatments. Subsequent results on the effect of weaning on fertility have shown a significant difference between continuous suckling and weaning lambs 2 days after birth. The results of further experiments have shown that the post-lambing level of nutrition has a considerable influence on fertility. In the case of ewes continuously suckled a lambing rate of 60-65% has been obtained by a high plane of feeding from lambing to mating together with hormone treatment at 8 weeks after lambing.