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Fertilising of High Producing Grass Swards

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Introduction

This paper describes the use of major nutrients (N, P. K) and secondary nutrients (magnesium and sulphur) together with lime and slurry for optimum grass production. The trace elements especially those of importance to the animal rather than the grass, e.g. molybdenum, cobalt, selenium, are not within the scope of this report. The designation 'high producing grass swards' refers to those capable of producing 12,500-15,000 kg dry matter/ha and capable of carrying 3.0 livestock units per hectare (0.82 ac per livestock unit). Usually such swards will be dominantly ryegrass with relatively little clover but some references will be made to old pasture and the significance of clover.

Nitrogen

Nitrogen is the most costly fertiliser for grassland. Up to £145 per hectare (£59 per acre) is commonly spent on this single element in Holland. It is therefore the element which has been most studied but is also the one on which there is least agreement regarding its optimum use.

There are at least four factors which affect the response of grass to nitrogen fertiliser and the amount of nitrogen needed.

1) Number of cuts.
2) Age of the sward.
3) Climate.
4) Soil type.

Nitrogen — Cutting

Much of the published literature on the responses of grass to nitrogen refers to experiments where the grass was cut 5-8 times per annum. This is very different from farm practice on conservation in Ireland which usually includes 1, 2 or possibly 3 cuts. Morrisson (1) working in the UK compared four cuts with six cuts on a number of sites and found that 390 kg N/ha was optimum with six cuts but only 280 kg N/ha with four cuts. High nitrogen requirements measured in Northern Ireland have been contrasted with lower amounts reported from experiments in the Republic of Ireland (2). It is likely that the number of cuts taken was the main reason for the difference which is illustrated in Figure 1.

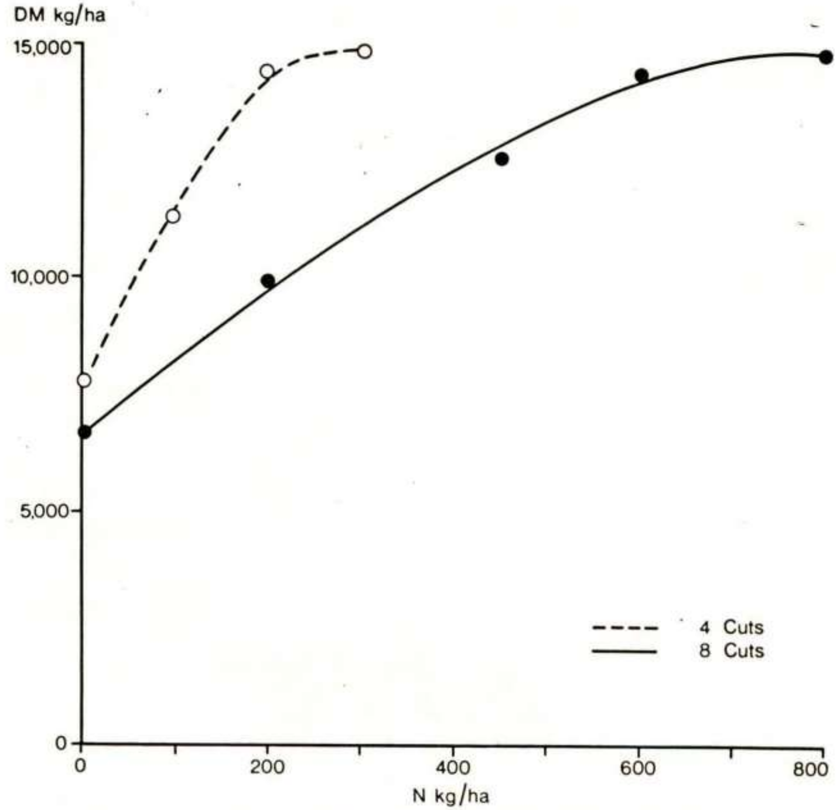

Fig. 1: A comparison between responses to nitrogen measured at Hillsborough using 8 cuts and Johnstown Castle using 4 cuts.

The two swards used in the experiments at Hillsborough and Johnstown Castle were very comparable in that both produced approximately 7,000 kg DM/ha with no nitrogen and both reached a maximum yield of approximately 15,000 kg DM/ha. But the sward at Hillsborough, which was cut eight times, required 600 kg N/ha to reach the optimum yield while that at Johnstown Castle, which was cut four times, needed only 200 kg N/ha to reach the same yield. We need to distinguish therefore between high requirement for nitrogen fertiliser and high yields or high responses in yield to nitrogen. In general yields in Ireland are as high as those in the UK or on the Continent.

There is little experimental evidence for the effect of age of sward on nitrogen requirement but there is considerable experience that a pasture needs approximately 50 kg N/ha extra for the first two years after establishment.

The effects of climate on nitrogen requirement are difficult to quantify but a series of experiments reported by Ryan (3) showed higher yields and higher nitrogen requirement along the south coast. This is probably related to the longer growing season in that region. The effect probably does not extend more than 15 miles from the coast.

In the same series Ryan also showed that clay soils were less responsive than average. Some variation is therefore to be expected in the correct amount of nitrogen to apply but if we consider the normal grassland systems in Ireland, i.e. one or two cuts of silage with 7 to 8 weeks interval between fertiliser application and harvest (25 May and 20 July) the variation is probably less than ±15%.

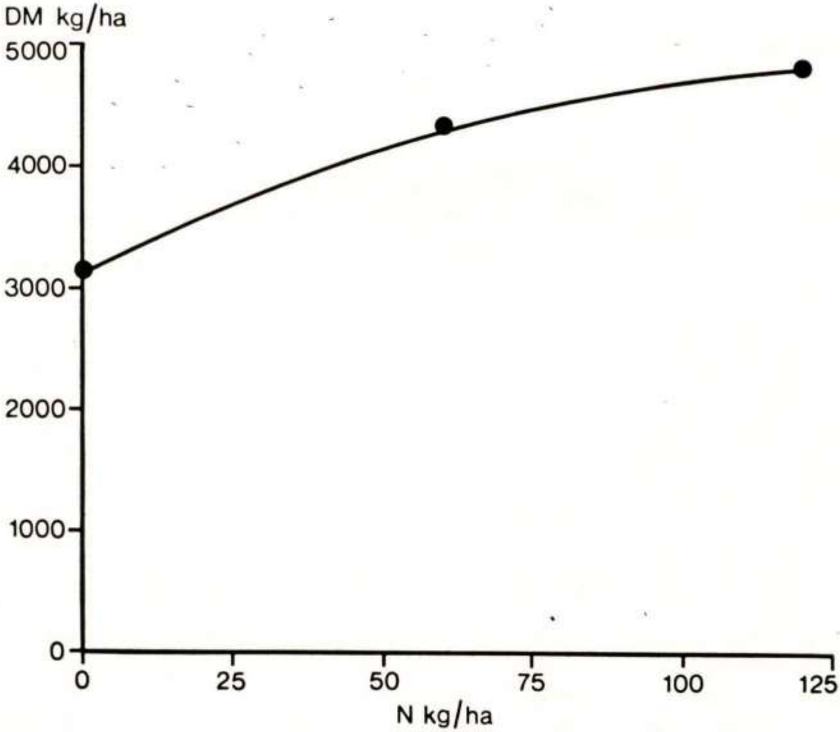

Fig. 2: Response of 1st cut silage to nitrogen (43 sites)
(W.E. Murphy)

Murphy (4) has studied the responses of grassland to nitrogen under cutting on a wide range of sites and for a number of years and recommended 100 kg N/ha and 85 kg N/ha as optimum for the first and second cuts of silage respectively. Figure 2 shows the average response for 1979. A response of 1550 kg DM/ha was obtained to 100 kg N/ha or 15.5 kg DM/kg N.

If a third cut is required a further 85 kg N/ha is recommended or a similar amount should be applied for grazing the aftermath. A sward which had been used for two cuts of silage would therefore receive 270 kg N/ha in the year in three-four dressings.

A change to a management system practised in Holland where silage is cut at much more frequent intervals with yields of 2500 kg DM/ha expected at first cut, compared to 4500 kg DM/ha in Ireland would require higher rates of nitrogen over the year. A better quality silage is claimed for such a system so it may be adopted more widely in the future.

Nitrogen — Grazing

The foregoing section referred to the use of nitrogen for silage. Experimental evidence for the optimum use of nitrogen for grazed swards is far less comprehensive. Many of the early experiments in the 1960's were carried out at low stocking rates which did not require righ rates of nitrogen. Three modern experiments carried out in the 1970's and extending into the 1980's are the most relevant to conditions in the Republic of Ireland today. McFeely *et al.* (5) working at Kilmeadon in 1973/75 with dairy cows concluded that rates of nitrogen higher than 250 kg N/ha were not justified. An early report by McCarthy (6) of an experiment still in progress at Moorepark supports this conclusion. Collins (7) working with beef animals at Grange concluded that the optimum amount of nitrogen was 120 kg N/ha. In doing this he emphasised the economic differences between dairying and beef as influencing the profit from nitrogen fertiliser but also pointed out that part of the reason for the poor response to nitrogen in his experiments was the very high output of the low nitrogen treatment which was probably due to a very vigorous clover sward. This is a very important aspect of the research on nitrogen use as the biggest differences between sites and between experiments is to be found between the low nitrogen treatments. The establishment of such highly productive clover swards is at the moment more an art than a science and may require 3-4 years grazing at intensities higher than ideal for production per animal. Much more detailed work is required on this topic which might profoundly affect nitrogen requirements.

Evidence available therefore suggests that there is no advantage in using more than 250 kg N/hectare for grazing for either beef or dairying and that lower rates may be optimum on some high clover swards. It is expected that with the current state of knowledge high productivity will be more reliably achieved with the nitrogen treatment than with clover. The nitrogen for grazing should be split into 5-7 applications.

In summary, 270 kg N/ha is recommended for two or three cuts of silage and up to 250 kg N/ha for intensively grazed swards.

Forms of nitrogen

Urea nitrogen is normally much cheaper than ammonium nitrate nitrogen and is equally effective under conditions of adequate rainfall. However in dry conditions losses may be as high as 50% so in practice results from Urea are not reliable between about mid May and mid August (8).

Phosphorus

The effects of phosphorus are less complicated than those of nitrogen At low soil levels very large responses can be obtained, e.g. 60 kg DM/kg P but soil levels can be built up at relatively modest rates of application. The strategy should be to build up reserves under grazing and then maintain this status by replacing the amounts removed in silage or in the animal.

Recommendations

Grazing	— Build up deficient soils	40 kg P/ha
	— Maintain soil status >4 ppm P	20 kg P/ha
Silage	— 1 cut	35 kg P/ha
	— 2 cuts	18 kg P/ha after 1st cut
		27 kg P/ha after 2nd cut

Soils differ in their capacity to store phosphorus and a fertile soil can be depleted within two or three years if neglected.

Potassium

The policy for potassium should be similar to phosphorus except that very large amounts can be removed under cutting (over 200 kg K/ha in two cuts) and the changes in soil status are more dramatic. The limestone soils in the midlands, Kildare, Offaly, Laois are particularly vulnerable. In one experiment carried out over four years the yield of grass fell from 10,200 to 4,800 kg DM/ha while soil potassium fell from 62 ppm to 23 ppm. In the Republic of Ireland this aspect is being neglected and some 43% of soil samples analysed after silage are deficient in potassium. Other fertiliser nutrients applied to silage are usually slightly above recommendations, so farm practice seems to be in error on this point even among intensive farmers.

Recommendations

Grazing	— Build up deficient soils	80 kg K/ha
	— Maintain status >74 ppm K	40 kg K/ha
Silage	— 1 cut	148 kg K/ha
	— 2 cuts	75 kg/ha after 1st cut
		110 kg K/ha after 2nd cut

Magnesium

Although low values of magnesium in herbage (0.1%) have been recorded in Ireland to responses in herbage yields to magnesium application have been measured. Over much of the country more than 20 kg Mg/ha are delivered every year in rainfall which apparently effectively maintains the magnesium status of the soil.

Low levels of magnesium in herbage are also associated with grass tetany in cattle and the herbage status can be increased by treating the pasture with dolomitic limestone. Such treatment however can only be considered on acid soil near a source of dolomitic limestone. In Holland this is considered useful insurance against tetany but in Ireland routine dusting of pastures or direct feeding with calcined magnesite is recommended.

Lime

The use of lime on pastures especially permanent pastures has been neglected in the Republic of Ireland. This may be because lime is slow acting compared to other fertilisers and a complete failure due to acidity in grassland is virtually unknown. Nevertheless lime can increase yields of grasses whether ryegrass or the poorer species associated with permanent pastures. It acts by releasing nitrogen from soil organic matter or by improving clover and by making phosphorus more available to the plant. Because of this, high rates of nitrogen and phosphorus can largely substitute for the effects of lime. This point is shown in Table 1 where the response of a pure ryegrass sward to lime at different rates of nitrogen is listed.

Table 1

Interaction of lime and nitrogen on grass yield (kg/ha)

	Lime	
N kg/ha	0	15t/ha (6t/ac)
0	4,800	7,000
100	8,600	11,300
200	12,700	14,360
300	14,700	14,800

At high rates of nitrogen the response to lime was very small compared to that at low rates of nitrogen but the amount of nitrogen needed to achieve a particular yield was higher on the unlimed than the limed plots. Because lime effects are long term—probably 10-15 years— it is cheaper to use it than to substitute nitrogen for it.

A pH of 6.5 is recommended for normal mineral soils. Maintenance of this status will require approximately 5 t/ha (2 t/ac) every 10 years. On soils which are high in Molybdenum as in areas of Meath, Westmeath, Kildare, Offaly the pH should not be increased above 6.0 as pH's above 6.5 will increase Molybdenum uptake which in turn will interfere with copper metabolism in the animal. On acid soils where 15 t/ha (6 t/ac)

is recommended the dressing should be split with an interval of 4-5 years between applications on top of the pasture. For establishment of new pastures where the lime is harrowed in, the full dressing should be applied before sowing.

Sulphur

It has been known for many years that sulphur is an essential element for plants and animals but it was not considered to be commercially important in Ireland before 1975. Following early work with grasses and clovers in pots, Hanley *et al* (9) measured a 16% response in DM yield under field conditions in Wexford in 1973. This experiment was carried out on a Screen series soil which is a very coarse sand and the results could not be extrapolated to other areas with confidence. However a survey of 112 silage crops in 1977 showed that 25% of these contained less than 0.20% sulphur which is generally accepted as a critical value. Field experiments in 1978 and 1979 carried out on 81 sites showed that restrictions of yield of more than 10% due to sulphur deficiency were widespread and were most common on light textured soils of low organic matter. Old pastures were affected as well as new pastures. Deficiencies were most common late in the season but in 1980, particularly with very low rainfall in April and May, the problem also occurred early in the year. At one site at Dunmore, Kilkenny, the DM yield increased from 9,600 kg/ha to 13,900 i.e. 45% increase following treatment with gypsum (calcium sulphate).

More recent work in 1979 and '80 has shown that ammonium sulphate, single superphosphate, ammonium sulphate nitrate, elemental sulphur and pig and cattle slurry are all useful sources of sulphur. There is some evidence available that split dressings are better than single dressings and there is relatively little residual value from one year to another.

Preliminary evidence from a feeding trial currently in progress at Johnstown Castle indicates that sulphur deficiency in silage may reduce liveweight gain in cattle as well as yield of herbage.

It is known that excess sulphur can interfere with copper metabolism in the liver and in this respect may aggravate the effects of high molybdenum. This should not be a difficulty in practice since in Ireland high molybdenum never occurs on light textured soils where sulphur would be deficient. However, it is a reason to avoid blanket treatment of all soils with sulphur.

Overall, some 1.5 million acres in the Republic of Ireland may be affected by shortage of sulphur. The light textured soils where it occurs are found in all areas but are most common near Carlow, east Galway, Tipperary and on the gravel soils in the midlands. The recommendations are :

25 kg S/ha applied in February plus 25 kg S/ha applied in June. Ammonium Sulphate 24% S, Ammonium Sulphate Nitrate 14% S and single superphosphate 12% S are all useful sources of sulphur. Fertiliser compounds usually contain less than 1-5% sulphur but 14.7.14 contains

8% S. Slurries contain variable amounts of sulphur and should be analysed if they are used as a source.

Slurry or farm yard manure

Some 80-90% of N, P, K in animal feed passes through the animal to the dung or urine and if it was all stored without loss and returned to the field in which the silage or fodder crop was grown the need for added fertiliser would be greatly reduced. However, storage, transport and handling are all expensive and usually neglected so the ideal closed cycle is seldom achieved. Because of enormous variation in practice due to either losses by leaching from farm yard manure or dungsteads or dilution in slurry tanks only general guidelines can be given here. Work by Kiely and Roche (10) has shown that most of the nitrogen will be lost if a dry period follows the spreading of slurry on top of grassland. In some circumstances yield may be depressed due to solids drying out on the herbage. If the nitrogen is applied in autumn it will be lost by leaching. The best time to apply slurry is in the mid-February to mid-March period, when some rain can be expected to wash the slurry into the soil without excessive losses from leaching or run-off. The slurry should be returned to the silage ground at 34 cb metre/ha. This dressing will probably provide 37 kg N/ha and 25 kg P/ha plus 150 kg K/ha.

Summary

The summary recommendations for N fertiliser are as follows:
Grazing:
Up to 250 kg N/ha split in 5-7 applications
plus
185 or 370 kg of 0 : 10 : 20 per hectare.
Silage:
34 cubic metre/ha of slurry in February/March
plus
65 kg N/ha at end of March;
85 kg N/ha plus 250 kg 0 : 7 : 30/ha after 1st cut, 25th May;
85 kg N/ha for aftergrass.

If slurry is not used add a further 35 kg N at the end of March i.e. 100 kg N/ha altogether plus 370 kg 0 : 7 : 30 fertiliser compound per hectare in autumn or early spring.

Check the analysis of slurry. Check soil analysis every five years and adjust rates of lime, phosphorus and potassium upwards or downwards to maintain soil fertility.

Apply 25 kg S/ha in February and again in June on light textured (sandy) soils.

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Developments in Beef Production in the Netherlands

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Beef production in the Netherlands has always been secondary to milk production and will remain so in the future. Contrary to most of our neighbouring countries there has never been a development of a specific beef breed or an independent beef production system. The few herds of foreign beef breeds like Charolais and Limousin are kept more as a hobby than as major sources of income. Thus, beef production has always been dependent on the dairy herd of Dutch Friesian (DF) and Meuse-RHINE-Ijssel (MRY) dual purpose breeds.

Nevertheless in the past twenty years major developments in beef and veal production have taken place. Previously, in the 1950's beef production consisted of grazing and fattening of culled cows and heifers and to a small extent grazing of steers, whereas at the same time about 700,000 newly born calves were slaughtered yearly. Since then specific production of veal caves and bull beef has been developed, which is of great importance for the farmers involved, the feeding stuffs industry, the slaughterhouses and the meat trade. Also, the dairy farmers have benefitted from higher calf prices.

Number of slaughterings

The trends in slaughterings of newly born calves and of veal calves are shown in Figure 1. It is clear that nowadays practically all calves are used for beef or veal production and that no reserve is left. As a consequence of the high demand, calf prices have been very high in recent years and to a small extent young calves have been imported from the U.K. and Ireland.

The slaughterings of full grown cattle in the period 1970-1979 are given in Table 1. Of a total of about 1 million slaughterings 60-65% were culled cows and 15-20% were culled heifers. As a consequence of the high level of (concentrate) feeding on the dairy farms most of these animals are ready for slaughter when they leave the dairy farm and they are sent to the slaughterhouses directly. According to the May census about 40,000 (6%) of these animals are fattened for some time on pasture or indoors before they are slaughtered. Fifteen to twenty per cent of the slaughterings consisted of steers and bulls. The percentage of slaughterings of steers decreased from 3 to 1% whereas the contribution of bulls increased from 11 to 18%. The total number of bulls that were slaughtered remained more or less stable since 1974.

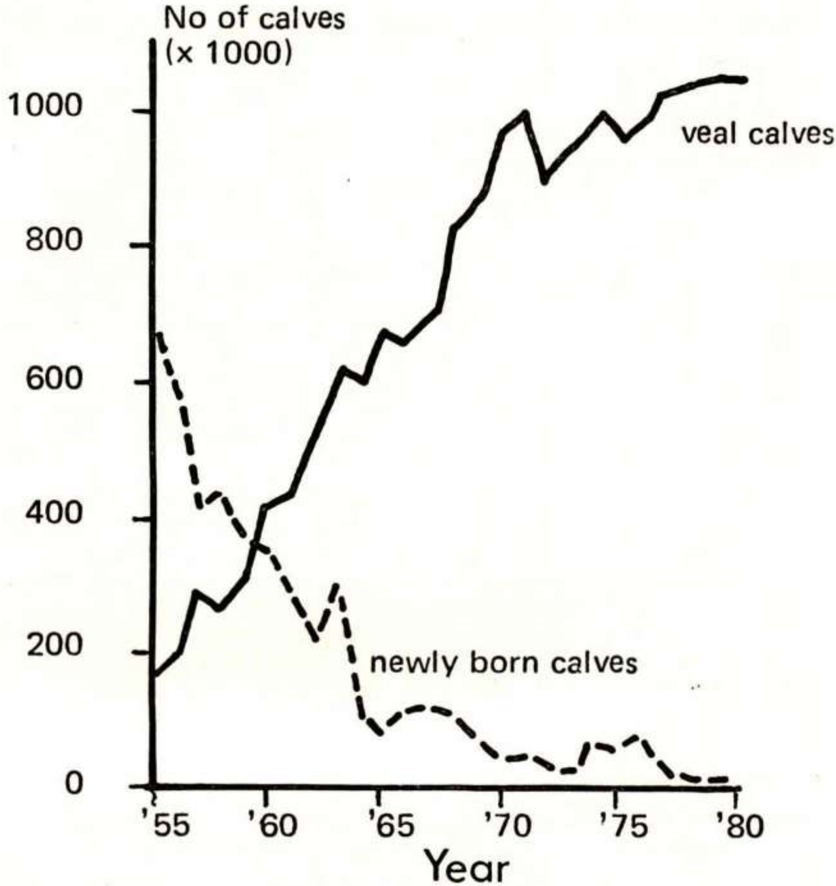

Fig. 1 : Slaughter of calves

Table 1

Slaughterings of full grown cattle (x 1000)

	1970	1975	1976	1977	1978	1979
Cows	552	614	620	570	556	625
Heifers	208	228	207	183	142	138
Steers	31	18	15	15	13	11
Bulls	102	198	184	183	176	167
Total	893	1058	1026	951	887	941

Structure of beef production

In the same period there was a strong development to increase the scale of operation. The number of farms with less than 20 beef animals decreased from 31,000 to 16,000 whereas the number of farms with more than 50 beef animals increased from 300 to 1000 (Table 2). In this regard there are strong regional differences. The development in beef production took place in the South and the East of the Netherlands. In this part of the country there is a sandy soil with possibilities for maize growing and a farm structure with many small mixed farms. Bull beef production developed here as a soil linked activity often in combination with some form of intensive livestock farming such as pigs or poultry. In the North and West of the Netherlands, farmers had more possibilities for specialization in dairy or arable farming. Consequently there was less interest in the development of beef production in this part of the country.

Table 2

Number of farms with young stock for beef production

Year	Number of animals per farm			
	1-19	20-49	50 and more	Total
1970	31,131	2,312	309	33,752
1978	17,888	2,770	958	21,643
1979	15,756	2,668	1,051	19,475

System or bull beef production

The common system of bull beef production is an intensive system in which newly born calves are weaned, fattened and finished entirely indoors without grazing. After a rearing period of three months in an insulated calf house the calves move into a non-insulated fattening unit. In the fattening stage the bulls are fed maize silage *ad libitum* plus a limited amount of concentrates (2-4 kg) for about a year. If grass is available on the farm, it is fed in summer in a zero grazing system and/or grass silage is fed in winter in combination with maize silage. Near industrial areas in some cases waste products of breweries, distilleries, potato chip industries, etc. are being used.

Calves may be purchased either directly from dairy farmers or from independent collectors. Most calves are brought to so-called collecting centres for further selection and are grouped according to the specific demand of the individual beef producers. The rearing and fattening is normally practiced on the same farm and there is no trading of animals of intermediate stages of production. Also, for the sale of the bulls the role of the live markets is decreasing and most of the bulls are sold directly to slaughter houses. The live markets are used primarily for the sale of steers, heifers and cows. Some farmers specialize in the rearing of so-called "start calves" that are sold as weaned calves at an age of 3 to 4 months. Most of these calves are sold for export to Germany and Italy. For bull beef, calves of the Red and White breed are preferred whereas the male calves of the Black and White Friesian and all female calves that are not kept as replacements are used for veal production. Male calves of the Red and White breed can be fattened in an intensive feeding system to a carcase weight of 300-320 kg without becoming overfat. With the Black and White Friesians the acceptable carcase weight in such a system is 280 kg.

Crossbreeding with beef breeds

With regard to the suitability for beef production of the available calves it should be kept in mind that the main interest of the dairy farmer lies in the production of milk. This is demonstrated in the development of first insemination of dairy breeds and beef breeds over the past five years (Table 3). It is clear from these figures that the major development has been in the use of semen from Holstein Friesian bulls and this means generally a decrease of the beef production suitability of the offspring.

Table 3

First inseminations in The Netherlands

Bull breed	Year				
	1975	1976	1977	1978	1979
Double muscled*	4,567	4,392	5,538	6,520	7,751
Limousin	2,685	2,333	1,768	1,590	1,346
Charolais	2,628	2,181	1,673	1,932	1,872
Piedmont	516	2,404	3,318	3,082	5,762
Chianina	101	73	102	—	11
Belgian Blue	308	493	508	626	632
Fleckvieh (Simmental)	25	34	44	46	45
Total beef breeds	10,830	11,910	12,951	13,796	17,419
Total dairy breeds	1,617,891	1,641,120	1,648,975	1,724,524	1,816,671
Beef as % total	0.7	0.7	0.8	0.8	0.9
NA Holstein as % total dairy	1.2	2.3	4.9	7.2	8.1

* Probably all MRY.

There is also an increase in the use of semen of the beef breeds but in 1979 this was still less than 1% of the total number of inseminations. In the beef breeds the semen of double muscled bulls of our MRY-breed is included and in 1979 these inseminations amounted to 44% of the total of the semen of beef breeds. The number of double muscled animals in the MRY-breed is small and there is only a limited commercial interest in the breeding and fattening of these animals. With the use of these double muscled bulls the use of caesarean sections at birth is normally accepted. On the other hand there is a certain interest on dairy farms for commercial crossbreeding with beef breeds, but only under the condition that there will be no extra risk at calving. In the 1960's there has been extensive research with the Charolais and Limousin breed. Bergstrom compared 9 Charolais and 9 Limousin bulls that were selected on easy calving. With regard to the effect on growth, conformation and fatness the Charolais crosses gave the best results, whereas the crosses of the Limousin and MRY were intermediate between the Charolais crosses and the pure Dutch Friesian. Although the Charolais bulls gave also the highest percentage of difficult calvings the results were judged acceptable for practical application (Table 4). On the basis of these results an insemination programme with Charolais semen was developed in practice.

Table 4

Percentage of difficult calvings and perinatal deaths (Bergström, 1964-1968

	Difficult calvings (incl. ceasareans)	Perinatal deaths
Ch x DF	9.2	3.0
Lm x DF	6.2	1.4
MRY x DF	5.1	3.0
DF x DF	1.8	3.7

During the practical application, the number of difficult calvings rose to a level that was not acceptable to the average Dutch dairy farmer. This had important implications not only for the Charolais breed but generally for the possibilities of the beef crosses in the Netherlands. In 1973/1974 another comparison between different beef breeds was made by Brunnekreef and in this experiment Piedmont crosses came out very well with regard to calving difficulties and beef production results (Table 5).

Table 5

Percentage of ceasareans and perinatal deaths (Brunnekreef, 1973-1974)

	Ceasareans	Perinatal deaths
Pd x MRI	2.1	2.2
Pd x DF	0.8	4.7

Since 1976 we have been working on Piedmont crosses with regard to calving difficulties and suitability of the crosses for bull beef, heifer beef and veal production (Tables 6, 7 and 8). So far the results have been promising and there is a growing interest in practice for the Piedmont

Table 6

Calving results from artificial inseminations Station W. Brabant (%) 1980

Sire breed	Pd	Li	Ch	DM-MRY
Number of births	283	152	172	131
Very easy birth	53.7	41.7	11.5	8.7
Normal birth	38.2	45.5	48.3	37.0
Heavy birth (1)	4.6	11.5	32.2	13.4
Ceasarean section (2)	3.5	1.3	8.0	40.9
Difficult birth (1)+(2)	8.1	12.8	40.2	53.3
Dead within 24 hrs	2.5	5.1	4.0	5.5

Table 7

De Vlierd and CR Waiboerhoeve young bull trials

Dam breed	MRY		DF	
Sire breed	MRY	Piedmont	DF	Piedmont
No. of animals	34	52	40	23
No. of days on farm	526	575	480	559
Initial weight (kg)	45	49	45	47
Final weight (kg)	553	584	494	548
DLWG (kg)	0.97	0.93	0.93	0.89
Total feed (k VEVI)*	3,280	3,740	2,830	3,500
Feed/LWG	6.5	7.0	6.3	7.0
Carcase weight (kg)	319	355	285	332
Killing out %	57.7	60.8	57.7	60.6
Carcase gain (kg/day)	0.56	0.57	0.54	0.55
Feed/carcase	11.2	11.4	10.9	11.4
IVO carcase classification				
Fleshiness	4	5−	4−	4+
Fat cover	3	3−	3	3−
Internal fat	3	3−	3+	3−
Price per kg carcase (DG)	7.35	7.80	7.15	7.50

* 1000 VEVI = net energy for growth of 1650 k cal/kg barley

It's true what they say, in Ireland the grass is greener.

When it comes to the quality of dairy pasture, there's no other country in Europe that Irish farmers need envy. Irish pasture land, Irish grass, is ideal for the production of the milk from which the world's best dairy products are made.

As a result, Irish dairy products are bought and enjoyed the world over–many of them bearing the world-famous Kerrygold label. They account for one-eighth of our total exports–an impressive £535 million plus–and because the import content is low, the economic contribution is huge.

But our world-wide market is steadily increasing and so we must maintain–and increase–our productivity to match that demand.

And if we do, that expansion will be matched by sales; sales of Irish butter, cream, powders, cheese and other dairy products.

So remember, we have the land,
we have the climate, we have the people.
Let's make the most of them.

AN BORD BAINNE
IRISH DAIRY BOARD

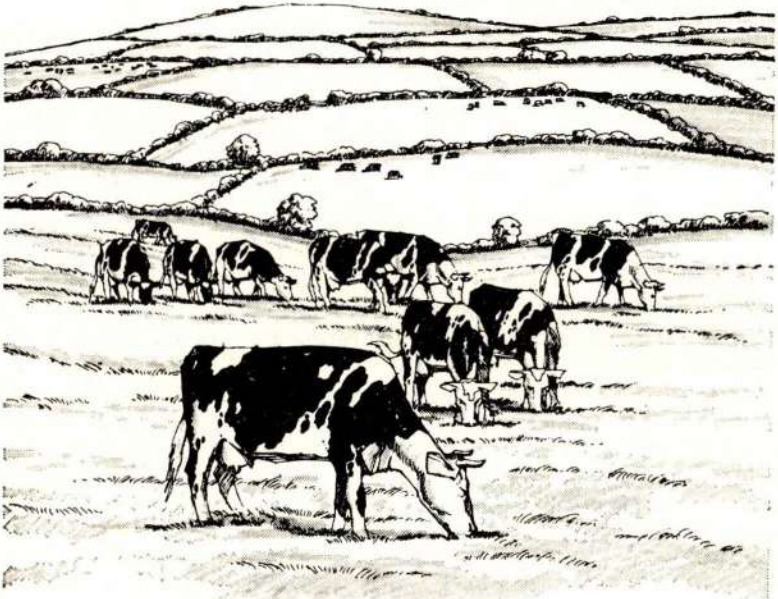

Table 8

Difference in value of calves of beef crosses in comparison with pure DF or MRY-breed (in guilders)

Trials		IVO	Hendrix Voeders	Research and Advisory Institute for Cattle Husbandry	
				Waiboerhoeve	De Vlierd
HF x HF	—	100			
HF x DF	—	50			
PD x DF			+275	+245	+330
Pd x MRY			+180	+235	+350

semen. In 1979 33% of the inseminations of the beef breeds were of the Piedmont semen. In 1979 33% of the inseminations of the beef breeds were of the Piedmont bulls. However, the results have been based on only a small number of Piedmont bulls that were not of the extreme double muscled type. The question is whether we will be able to select in future sufficient bulls of the intermediate type of Piedmont bulls. If we succeed in this there will certainly be more interest for this type of beef cross on the average Dutch dairy farm.

The requirements for further progress are :

1. Guaranteed easy calvings.
2. Guaranteed colour marking.
3. Guaranteed higher prices.

At this moment the Piedmont crosses meet more or less these requirements.

Feeding systems

Another important aspect of profitable beef farming is the feeding system. Under our circumstances feeding costs form about 50% of total production costs. The system that has developed as the common system is based on the use of 50 kg milk replacer during the rearing period, and from three months of age onwards maize silage *ad libitum* is complemented with 2-4 kg of concentrates. In such a scheme MRY-bulls will be ready for slaughter in 16 months with a carcase weight of about 300 kg. Of course all kinds of variations in the ration are found depending on the availability of certain feeding stuffs.

Ons of the aspects of most interest to Irish farmers is the role of grass and grass silage in such a system. In the Netherlands, on many farms with bull beef, some grass or grass silage is available. One of the possibilities is feeding the grass as fresh grass in a zero-grazing system. This can give good technical results but has relative high labour and machinery costs. The feeding of fresh grass in summer and grass silage in winter increases the need for concentrate supplementation with at least 2 kg of concentrates per day. This is demonstrated in Table 9 where results are given of an experiment where grass silage was compared with maize silage. With a fixed level of 2 kg of concentrates extra with the grass silage ration, results were even slightly less with the grass silage ration in comparison with the maize silage ration.

Table 9

Comparison of maize silage and grass silage in rations for bull beef

	Maize silage + 2 kg of concentrates	Maize silage + grass silage + 2 kg of concentrates	Grass silage + 4 kg of concentrates
Number of animals	20	18	19
Number of days in experiment	352	360	361
Daily liveweight gain (g)	1108	1047	1039
Carcase weight (kg)	315	299	297
Killing out percentage	59.4	57.9	57.2
KVEVI per kg growth	6.0	6.0	6.7
Price per kg carcase (f)	7.24	7.24	7.28
IVO carcase classification			
Fleshiness	40	4−	40
Fat cover	30	3−	3−
Internal fat	30	3−	2+

Another experiment was aimed at the question whether it was best to give grass silage in the early period or in the final fattening period. By offering a product in the first half of the fattening period the total intake of that product is lower because the intake per animal is in that period lower.

From Table 10 it is clear that the fattening period was shorter, the price per kg carcase was higher and the feed conversion was better as the amount of maize silage in the diet increased. From this experiment it was concluded that when grass and maize silage are available on a farm and when one wants to feed one product at a time to a certain group of animals it is best to feed grass silage to the younger animals and reserve the maize silage for the final fattening period.

A recent development to improve feed conversion in rations for beef production is the addition of growth promoters like Monensin and Flavomycine. Since 1978 these two antibiotics are accepted in the Netherlands as feed additive to concentrates. The effect of Monensin was studied in a series of experiments in co-operation with Eli Lilly Benelux. The results are given in Table 11. In the all-concentrate ration, the amount of concentrates was kept at the same level and no difference in growth rate was found. In the rations with maize silage and grass silage

Table 10

Comparison of maize silage and grass silage in rations for bull beef

	Only maize silage	Maize silage followed by grass silage	Grass silage followed by maize silage	Only grass silage
Number of days in experiment	389	424	393	448
Number of animals	37	37	36	39
Concentrates per day (kg)	2.2	3.1	2.8	3.5
Daily liveweight gain (g)	1082	1012	1048	920
Carcase weight (kg)	322	320	317	312
Killing out percentage	57.9	56.7	58.0	57.0
KVEVI per kg growth	6.6	7.3	7.1	8.0
KVEVI from grass silage	—	1029	606	1725
Price per kg carcase (f)	7.29	7.19	7.23	7.17
IVO carcase classification				
Fleshiness	40	40	40	4−
Fat cover	30	3−	3+	2+
Internal fat	30	3−	30	20

there was in both cases a decrease in the roughage intake and an increase of liveweight gain. This led to an improvement of the feed efficiency of 7.2% in the maize silage ration and of 6.8% in the grass silage ration. In these two cases in the rumen a significant increase in the percentage of propionic acid was found and a slight non-significant increase in the pH.

Table 11

Effect of Monensin in rations for bull beef

Basic ration Roughage	Concentrates 1 kg straw	Maize silage Maize silage ad lib	Grass silage Grass silage ad lib
Concentrates	2-10 kg	2-3 kg	2-6 kg
Mg Romensin (Na-Monensin) per kg concentrates	40	125	80
Daily liveweight gain (g)	996	1116	1109
Increase liveweight gain (9)	−17	+40	+68
Decrease roughage intake (%)	—	− 5.5	− 1.6
Increase feed efficiency %	− 1.7	+ 7.2	+ 6.8

Health problems

An important condition for a good economic result is a minimum of illness and mortality during rearing and fattening. On average veterinary costs amount to £30 per animal and mortality about £50 per animal. The main risk is an outbreak of some bacterial or virus infection that can cause high losses in incidental cases. The first difficulty encountered by fatteners of young bulls is the acquisition of sound animals as starting material. In the rearing phase, bacterial infections with Coli, Salmonella and Pasteurella form the main problems. In this phase good hygiene and ventilation in combination with immediate treatment in case of illness are essential. In a later phase virus infections with IBR (Infectious Bovine Rhino Trachitis) and RSBV (Respiratory Syncytial Bovine Virus) can be very dangerous. At an age of 3 months normally all animals are vaccinated against IBR and about a month later against RSBV. The main problem is that the RSBV vaccination is too late and that animals are already infected in a younger stage. Research is now in progress to protect the animals already in a younger phase. Losses and bad growth at an older age are often a result of a respiratory infection in early life.

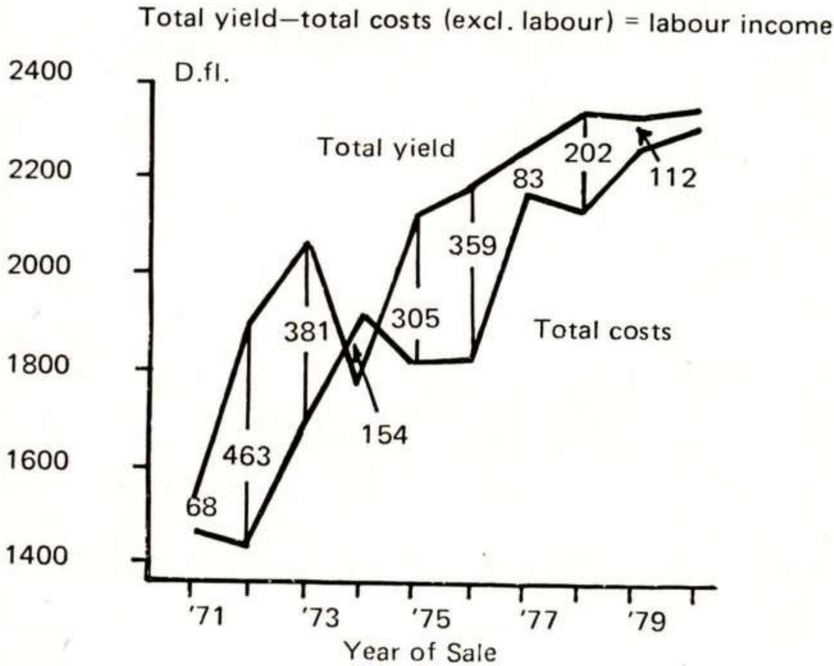

Fig. 2 : Labour income per bull

Economics of bull beef

The principal factor in the development of bull beef production was of course the financial result of this specialization. In Figure 2 the labour income per bull is given for selected farms with bull beef production registered by the Agricultural Economics Research Institute. This labour income per bull varied in the past nine years from −f154 to +f463 (Dutch guilders). On average the result was an incentive for a further specialization in this direction. Also the E.E.C. intervention scheme has had a positive influence on this development.

On the other hand the variation in labour income from year to year makes clear that variations in calf prices, feeding stuffs prices and meat prices strongly influence the result in the short term. Also it is clear from the development of yield and costs that the calculated labour income has gradually decreased. The increase in meat price has been insufficient to compensate for the rise in cost of the purchased calf, feedingstuffs, housing, interest, etc. High calf prices especially, as a result of the high demand for veal production, have had a negative influence on profits in beef production. The result has been that in 1980 practically no new investments were made in bull beef production.

It is necessary to make some remarks on the calculated costs for roughage, buildings and interest. With regard to the roughage costs, roughage is calculated against a market value of f0.35 per kg VEVI or f3500 per ha. In the case of growing of maize on owned property, with cultivation, harvest and conservation carried out by a contractor one has to deal with f1500 direct costs per ha. In this case there is an additional yield of f2000 per ha or f250 per bull as profit from the land to add to the calculated labour income. With regard to the calculated costs for buildings, mechanization and interest on working capital the total amounts to f370 per bull.

It is clear that the profitability of beef production very much depends on the farm situation with regard to ownership of land and buildings and the relation between own and borrowed capital. With a lot of property and capital many of the calculated costs are not felt as direct costs. This is perhaps an important explanation why, as a result of the strong competition, much more is paid for calves for beef and veal production than is possible on an economic basis. Unfortunately there are few possibilities for the individual farmer to evade the strong negative influence of high calf prices on the profitability of beef production. With a decrease in the number of dairy cows in the E.E.C. the competition for calves will increase further. This would give an opportunity for suckler herds to expand and provide a higher proportion of calves for beef production.

Beef Production from the Suckler Herd in France

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In a Farm Study Tour of France suckling systems based on the Charolais breed were examined and this report describes the relevance of those systems to Irish conditions. The Charolais breed was selected as it accounts for about 40 per cent of the total suckler herd in France and is representative of the later maturing, faster growing breeds. Before discussing suckling systems, a brief outline of beef production in France is presented.

Cow herd

The size and composition of the cow herd in France is shown in Table 1. Twenty-seven per cent of the national herd are suckler cows. While only 23 per cent of dairy herds and 17 per cent of beef herds have more than 20 cows, there has been a gradual increase in herd size in recent years. In 1969, only about 5 per cent of herds had aver 20 cows.

Table 1

Cow herd in France 1979

	Dairy	Beef	Total
Number of cows (million)	7.5	2.7	10.2
Percent of total cow herd	73	27	100
Average number of cows per herd	13.8	12.0	
Percent of herds with over 20 cows	23	17	

Type of beef produced

Table 2 shows that the most prominent type of beef production is veal although the number of calves used for veal has declined from 4.4 million in 1969 to 3.5 million in 1979. Cows account for 43 per cent of the total with the remainder consisting of heifers, steers and bulls in roughly equal proportions. It is noteworthy that bulls have increased from 0.28 million head in 1969 to 0.75 million in 1979. However, bull beef is not consumed in France and most of it is exported to Italy, Belgium and Holland.

Table 2
Beef produced in France

	1969 (million)	1979 (million)	1979-1000 tonnes	%
Cows	1.86	2.12	645	42.8
Heifers	.76	.78	227	15.1
Steers	.95	.93	342	22.7
Bulls	.28	.75	254	16.9
Total mature animals	3.91	4.73	1506	
Veal	4.38	3.45	377	

Suckling

Although herd size is small most of the 2.7 million suckler cows rear only their own calf with less than 10 per cent of cows used for multiple (mainly double) suckling. In general, there is little interest in multiple suckling as in addition to the labour involved, there are more problems due to increased incidence of calf scours. Lack of interest in multiple suckling is understandable as most beef cows are pure beef breeds with relatively low milk production potential. The most prominent beef cow is the Charolais which totals 1.07 million or almost 40 per cent of the beef cow herd. These are followed by Limousin which total about 0.4 million or 15 per cent of total beef cows. A number of different breeds contribute to the remainder with a relatively low proportion of crossbred cows.

Charolais herds

The Charolais herds are predominantly found in the central region of France (Nevers, Bourges) but herds are also present in other areas. There are about 4,000 pedigree Charolais breeders and only approximately 10 per cent of the total breed is registered. Thus, the vast majority of Charolais animals are used for commercial beef production.

The production system practised in the Charolais region (central France) can be summarised as follows:

1. Age at first calving is three years. Some producers have attempted calving at two years of age but this is generally avoided due to excessive calving problems.
2. The incidence of caesarean births is reported to be about 7 per cent in heifers but the incidence is low in mature cows with an overall level of about 3 per cent.
3. The average number of calves produced per cow is 5. In general, cows are retained as long as they remain productive.
4. Average calving date is early March (range January-May) and cows are generally calved indoors.
5. The usual method of breeding is by running a bull with the herd. However, in certain areas artificial insemination may be used on a

high proportion of the herd but usually a bull will be introduced later in the breeding season.

6. Highly muscular bulls are avoided for breeding purposes because of calving problems.
7. Cows are generally let to pasture in April and are housed in the period November-January. Depending on the season and region some supplementary feed, such as hay, may be fed at grass during dry periods.
8. Cows usually receive hay in winter and very little grain is fed. In certain areas grass silage and maize silage may also be used for feeding the cows.
9. Calves are weaned in October/November and in the past were sold as stores at 20 months of age for fattening elsewhere. Presently, weaning bulls (about 300 kg) are frequently sold for fattening to Italy or other regions of France where maize silage is grown. Bulls may also be retained until they are 15 months old and then sold for fattening elsewhere or may be fattened on maize silage on the farm. Heifers may be sold or retained for fattening at 2-3 years.

   Charolais herds are also maintained in the Nantes region on the west coast. Maize silage is produced and all the progeny are fattened on the farm. Additional Charolais bulls are also purchased for fattening. It was generally accepted that the production of finished animals was more profitable than selling weanlings.

Fattening systems for bulls

In the western region the development of intensive fattening systems using bulls coincided with the production of maize silage. In addition to the bull calves born and reared on the farms, extra bulls are purchased at weaning (280-300 kg liveweight) and all are fattened over the following 10 months. A typical ration per animal daily is :

maize silage	—	to appetite
grain	—	1 kg
soya bean meal	—	1 kg
minerals/vitamins	—	150 g

There can be slight variations to the above ration depending on silage quality and usually the level of grain is increased to 2 kg during the last 2-3 months of fattening. Liveweight gains are about 1.3 kg daily during the fattening period and final carcass weights 410 kg. Yields of maize silage are about 10 tonnes of dry matter per hectare and it was estimated that about 4 bulls could be fattened per hectare. In some instances the bulls are purchased for fattening at about 15 months weighing 450 kg and fattened over a 4-5 month period on a similar diet based on maize silage (daily gains 1.4 to 1.5 kg per day). While the area devoted to maize grain in France has remained relatively constant during the 1970's at 1.5 million ha., the area of maize silage has increased from 0.31 million ha. in 1970 to 0.98 million ha. in 1977.

To indicate the potential of the various breeds body composition and feed efficiency data of fattening Friesian, Charolais and Limousin bulls are shown in Table 3. Despite heavier final weights, liveweight and carcass weight gains were greater for the beef breeds than for the Friesians.

Table 3
Composition of body gain and feed efficiency of young bulls

	Friesian	Charolais	Limousin
Initial weight (kg)	341	366	350
Final weight (kg)	515	602	559
Daily gain (g/day)			
Liveweight	1194	1258	1178
Carcass weight	693	790	788
Muscle	452	581	581
Protein	203	235	232
Feed efficiency (g/Fu)			
Liveweight gain/Fu	155	161	168
Carcass gain/Fu	91	101	112
Muscle gain/Fu	59	74	83

(Robelin et al, 1978)

Likewise, they were more efficient in converting feed to carcass gain and in particular muscle gain.

Other results (Grey and Roblein, 1978) have shown the advantages in terms of growth and feed efficiency of Limousin compared with Friesian bulls when taken from 300 kg liveweight to slaughter (Table 4). At a carcass weight of 300 kg, Friesian and Limousin carcasses contained 201 and 231 kg of muscle, respectively. The corresponding figures for fat in carcasses were 19.2 and 10.6 per cent.

Table 4
Differences between Friesian (F) and Limousin (L) breeds at slaughter

Slaughter criteria	Body weight (kg)		Carcass weight (kg)		Muscle weight (kg)		Fatty Tissues	
	F	L	F	L	F	L	F	L
Same age : 16 months	500	540	274	325	185	258	17.9	11.3
Same bodyweight	550	550	303	341	203	262	19.3	11.4
Same carcass weight	545	486	300	300	201	231	19.2	10.6
Same fatness	318	597	169	372	119	285	12.0	12.0
Same feed efficiency 180 g of gain/feed unit (from 300 kg to slaughter)	425	600	230	374	158	287	15.5	12.1

(Geay and Roblein, 1978)

Fattening systems for heifers

Unlike bulls, there is no clear fattening system for heifers. In general a heavy final liveweight of about 500-600 kg is the objective. Rapid fattening from weaning is not generally practised and the majority are fattened at between 2 and 3 years of age. Thus, at least one winter store period followed by a second grazing season precedes fattening. When fattened in winter, maize or grass silage and supplementary concentrates are used.

Cattle prices

As a guide to the prices obtained for Charolais animals, a list of prices for Autumn 1980 are shown in Table 5. Friesians are included for comparison purposes and it is obvious that quite a premium is available for Charolais, particularly heavy cull cows. While accurate prices could be obtained for the different carcass grades, it was difficult to obtain figures for the different breeds, and thus the data in Table 5 should be used as a guide to prices rather than a precise assessment. With regard to prices received, a lot of emphasis was placed on the conformation of the animals and when conformation is very good, higher prices can be obtained. For any particular class of animals, prices also tended to rise as carcass weight increased. The price of young weaned Charolais bulls was £150 per 100 kg liveweight in October 1980.

Table 5

Cattle prices in France—Autumn 1980

Type of Animal	Price per kg of carcass (P)
Charolais bulls	190 - 195
Friesian bulls	155 - 165
Charolais heifers	190 - 195
Young Charolais cows	178 - 184
Older Charolais cows	161 - 172
Friesian cows	126 - 138

Advantages compared with Irish conditions

The farmers involved with fattening Charolais bulls were all members of producer groups (usually 300-600 members per group). The producer groups operate in co-operation with ONIBEV (the French national interprofessional cattle and beef industry development agency) who in addition to providing technical information are involved in operating intervention, carcass classification, market research and aids to producer groups. The overall objective of ONIBEV is to increase the efficiency of beef production by improving production at farm level and marketing of the produce. The advantages of membership of a producer group include :

1. Arrangement of loans amounting to a maximum of 80 per cent of the

sale value of the animal at an interest rate of 10.7 per cent. These loans are provided by Credit Agricole. The producer group will guarantee the loans but in general ONIBEV would prefer that the loan should not exceed the purchase price of animals.

2. By signing a contract to sell animals through the group, the sale price of bulls and steers is guaranteed. The guaranteed price is approximately 96% of the guide price and if market prices are lower at sale the difference will be paid. However, it is necessary that the animals reach slaughter at the pre-arranged date and meet the specified weight and quality requirements. Only animals in EURO of the EUROPA classification scale qualify for the guaranteed prices. The overall rejection rate appears to be low. No such guarantee applies to heifers or cows. Veal is not eligible.
3. There is a minimum guaranteed price for suckled weanling bulls which in 1980 was £138 per 100 kg liveweight for Charolais. However, as the market price was £150 per 100 kg this would not apply.
4. A flat rate headage premium is paid which varies with the duration of the contract. The premium per head is £5.80, £11.60 and £17.40 when the animals are retained on the farm for longer than 6, 12 or 18 months respectively.

In addition, the French Government have agreed to make headage payments similar to the E.E.C. in the recently introduced Beef Cow scheme up to a herd size of 40 cows.

Membership of a group involves a charge of about £15 per animal but there is a net gain from membership in addition to the credit facilities. The membership charge includes cost of animal transport and other such facilities.

Application of Charolais systems to Irish conditions

As neither availability of purebred Charolais or maize silage apply, a proposed system for Ireland would have to be an altered version of the system practised in France. The big attraction of the French system includes:

1. the high prices per kg paid for both the progeny and cull cows
2. high sales of carcass per cow due to slaughter at heavy weights.

A proposed system for Ireland would not necessarily include just one breed and first calvings at three years of age as practised in France is undesirable. It is therefore proposed that starting with possibly a Charolais X Friesian heifer, these could be bred to calve at two years of age using a Limousin sire. Charolais or Simmental sires would be used subsequently but Limousin sires would continue to be used on replacement heifers. In the early years a high rate of turnover of the cow herd would be necessary to allow upgrading with replacements coming from within the herd.

A definite decision would need to be made initially as to whether to produce young bulls for sale at about 18 months of age or steers at 24-26 months. While the steers would be suitable for the French market the markets for the bulls would include Italy, Belgium and Holland.

Production of bulls at 17-18 months

Assuming February/March calving the bulls could be sold fat in July at about 17 months. Weaning would take place in November and they would be fed indoors from November to slaughter on high quality grass silage plus concentrates. Liveweight at weaning would be about 300 kg and assuming a daily gain of $1\frac{1}{4}$ kg per day a feeding period of 240 days is needed to provide a total gain of 300 kg and a final liveweight of 600 kg. While this is lower than the final liveweight obtained in France with the pure bred Charolais, mature size would be less particularly when upgrading and due to the use of Limousin sires on heifers. To achieve these targets it is essential that the silage must be of very high quality. Using silage with a dry matter digestibility in excess of 75 per cent, the performance of Charolais cross bulls in experiments at Grange (Table 6) indicate that these weight gains can be achieved.

Table 6

Performance of fattening Charolais bulls fed high quality silage and concentrates

	Winter 1975/76 Concentrates (kg/day)		Winter 1976/77 Concentrates (kg/day)	
	4.5	3.0	4.5	3.0
Weaning weight (kg)	279	273	273	272
Slaughter weight (kg)	475	461	487	479
Daily gain (kg)	1.18	1.14	1.27	1.23

Fattening at two years

In this system no attempt is made to fatten during the first winter and the animals are let to pasture for a second grazing season. They are subsequently fattened during the second winter on high quality silage and concentrates to give carcass weights for steers in excess of 340 kg. A similar type system could be used with bulls but management of the older bulls at pasture may not be suitable in all situations and in general when bulls are produced it is preferable to fatten at the younger ages.

Economic returns from Continental type suckling systems

The following inputs and outputs are proposed for a system in which by ugrading and retention of replacements from within the herd, a herd is developed with a very high proportion of Continental (Charolais, Limousin or Simmental) blood. Bulls are fattened at 17 months of age and when fed silage plus 3 kg of concentrates daily from weaning to slaughter attain a carcass weight of 350 kg. Heifers are fattened at two years of age and fed silage plus 1.0 and 2.5 kg of concentrates per head daily during their first and second winter periods, respectively. In the earlier years a high replacement rate is proposed and carcass weights of young cull cows and heifers are estimated to be 300 kg. The area of grassland (grazing plus silage) required per cow and progeny to slaughter is 1.7 acres. Using these figures and either standard cattle prices, or a premium of 30p per kg of carcass above standard prices gross margins per cow and per acre are shown in Table 7. The gross margins per acre, using standard prices, are quite similar to those expected where using a Friesian cross (preferably Limousin) suckler dam sired by a continental sire breed. Therefore, in order to have a worthwhile financial advantage from the introduction of a specialised continental type suckler herd, it is essential that a premium, of the order mentioned, is obtained for the carcasses.

Table 7

Gross margins (£) per cow and per acre

	Per cow	Per acre
Standard prices	272	160
Premium 30p/kg of carcasses	370	217

In the foreseeable future, the dairy herd in Ireland will not provide adequate numbers of calves and, in fact, it is desirable to increase the size of the suckler herds. Presently suckler cows account for approximately 25 per cent of the total cow population. As growth rate of the progeny and final carcass price are important, continental sire breeds should be used on suckler cows. The dam used would ideally (depends on supply) be a Limousin x Friesian from the dairy herd resulting in the production of ¾ continental progeny. The question arises as to whether this system be altered and replacements used from within the herd to upgrade towards a 100 per cent continental breed type.

Conclusion

The continental type suckling system described above would be very specialised and the standard of management required is high. To achieve a high degree of success individuals undertaking the system should form a producer group which would be concerned both with production and marketing. As the prices obtained for the animals will be as important as high technical achievement, close association with outlet markets is essential. This is one area which allows meat factories to get involved from the outset with a producer group. The factories should be in a position to outline the type of animal required and guarantee a price for the following year relative to the prevailing price of Friesians provided the product produced meets the standards laid down. It must be appreciated that numbers of animals will be low in the initial years but these would increase rapidly provided the economic returns were satisfactory.

To ensure satisfactory numbers of suckler cows, it is essential that a suitable Beef Cow Incentive Scheme is available on a continental basis. Such a scheme is not only in the interest of beef cow herd owners but also of beef farmers, meat factories and the community in general to ensure an adequate and constant supply of beef.

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Calf to Beef at Eleven Months of Age on an All Barley Diet

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In the mid 1970's I sought a more profitable beef production system for my farm which was then based on the winter fattening of store cattle and on a two-year calf to beef system.

Barley beef offered a number of advantages:

1. Performances are predictable and could be costed accurately.
2. Early slaughter at under one year would require less capital than other calf to beef systems and give a higher return on the capital employed.
3. The use of bulls would give better liveweight gains and food conversion.
4. The use of Romensin would improve feed conversion figures.
5. Labour demands would be low—less material to handle, no fencing, dosing or herding required.
6. The existing land could be used to grow grain and offer an alternative income for a low capital requirement.

The system of barley beef production is a simple one. Dairy bred calves are reared on an early weaning system and at 10-12 weeks are introduced to an *ad libitum* diet based on rolled barley and containing about 15% crude protein. When the cattle are 6 months old and weigh approximately 250 kg the protein level is reduced to 13%. The cattle are sold on average at 11 months of age weighing 425 kg.

The system in practice

A new specialist calf rearing house was erected in 1979 for 144 calves with 12 pens each holding 12 calves. The pens, either side of a central passage, are straw bedded with sloping floors to remove as much liquid as possible, this being piped outside to a tank. A semi-automatic feeder is used for milk feeding.

Calves are purchased from March to June as this means that the bulls come out as finished beef in the late spring when fat cattle supplies are low and therefore can command top prices. All Friesian calves are now purchased, since the Continental types proved too variable in performance with only 30% justifying their extra initial cost.

After weaning the calves are transferred to a slatted house where they are matched in groups of 25-30 and these groups remain intact until slaughter. The barley diet is placed in troughs using a simple farm built trailer with a side delivery auger. The cattle also get about ½ kg straw/head daily to help the rumen function.

Health problems at the calf stage include scours and pneumonia. Good housing helps prevent pneumonia and vaccination is useful against salmonellosis.

At the post-weaning stage and up to 6 months of age pneumonia outbreaks may still occur. These are usually best dealt with by medicating the meal and water for 3-4 days.

Production targets

Liveweight at slaughter (kg)	425
Carcase weight (kg)	233
Age at slaughter	11 months

Feed consumption (kg)

Dried milk	20
Calf nuts	50
Moist barley	1500
Soya bean meal	100
Minerals etc	40
Straw	10

Feed costs can be minimised as follows :

(1) Moderation in use of milk.
(2) Avoiding over-use of expensive calf nuts.
(3) Purchase moist barley at harvest when prices are lowest.
(4) Use urea to replace some of the soya protein in the finishing ration.
(5) Use Romensin to improve feed conversion rate.
(6) Protect against birds and vermin.

Marketing

The beef from these young bulls is a superior product and needs to be distinguished from that of older cull bulls and heavy bulls from grass based systems. They are lean and well fleshed and don't have the heavy neck development of an older bull. On boning out these young bulls will yield an extra 3-4% meat over and above that of a similar steer.

However, the best price is got by scarcity, and my selling policy is to have the bulls ready for sale during the spring period.

My bulls are mostly sold for the local trade which favours a lightweight carcase and pays a premium for it. Some are also sold for a vac-packing operation where the extra 3-4% yield can be realised by the processor and a premium subsequently paid.

Production Responses and Consumer Protection following the Use of Anabolic Agents in Beef Production

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The use of growth promoters in beef production in Ireland has been described in a previous article in this journal (Roche, 1979). In this paper, the present position as regards use of growth promoters in beef cattle is summarised and the safety of meat to the consumer following implantation is discussed.

Use in finishing steers

The available growth promoters, used as ear implants, are shown in Table 1. Ralgro will increase growth rate by 10-18% and give an extra 7-10 kg of carcass weight over a 120 day experimental period. Finaplix will increase growth rate by 15-25% and give an extra 8-19 kg carcass weight over a 4 month period. The feed additive, Romensin, will increase daily gain by 10-15% and carcass weight by 6-10 kg over a 4 month period. Animals to be given Romensin should be introduced to it gradually and fed 200 mg per day per animal.

Table 1

Available growth promoters, used as ear implants, in Ireland at present

Compound	Abnormal behaviour	Male or female effect	Type of hormone
Finaplix	No major effect	Male	Synthetic androgen
Ralgro	No major effect	Female	Non-hormonal chemical; acts like oestrogen
Synovex-S (steers)	Bulling, mounting, udder development	Female	Natural oestrogen and progesterone
Synovex-H	Bulling, mounting, udder development	Female	Natural oestrogen and androgen

Research has shown that male type and a female type growth promoter gives an additive response. Thus, Ralgro + Finaplix will increase growth rate by 25-30% and carcass weight by 21-20 kg. Both implants can be inserted at the same time. Also, Synovex-S + Finaplix will increase growth rate by 25-40% and carcass weight by 12-25 kg. However, the behavioural side effects of Synovex-S must be considered and these will be discussed later.

Summary of combinations to use in steers

The major points to remember are that additive responses are obtained when (i) a male + a female type growth promoter are used or (ii) a growth promoter + Romensin are used.

1. Male + female type growth promoter — both additive e.g. Ralgro + Finaplix.
2. One growth promoter + Romensin — both additive e.g. Ralgro + Romensin or Synovex-S + Romensin.
3. Male + female growth promoter + Romensin — are they additive? e.g. Ralgro + Finaplix + Romensin — In two of three experiments, no additive response was found in steers fed Romensin when already implanted with Ralgro + Finaplix.

Use in female cattle for beef production

In contrast to the increased growth rate obtained in steers following the use of growth promoters, the growth response in finishing females is lower and more variable. The reasons for this are not clear at present. A summary of Grange trials indicate the following:

i) Non-significant responses to Ralgro when inserted 1-1½" from base of ear.
ii) Significant responses to Finaplix in winter when animals are gaining over 0.55 kg/day and in summer on pasture (4-8 kg carcass gain).
iii) Significant responses to Romensin (4-8 kg carcass gain).
iv) Neither Ralgro + Finaplix nor Romensin + Finaplix are additive in their growth response in heifers.
v) Synovex-H induces udder development in 20-35% of heifers so they may be classified as cow heifers in meat factories.

Therefore, the present state of knowledge indicates that in heifers being finished for beef, either Finaplix **or** Romnsin, give significant responses. In cull cows Finaplix **or** Romensin **or** Synovex-H can be used.

Effects on feed efficiency and carcass quality

Trials carried out where feed intake has been measured in steers given Ralgro + Finaplix indicate a 3-4% increase in feed intake for a 30% increase in daily gain. Thus, a major effect of growth promoters is to increase feed efficiency. In addition, the hormonal implants have a positive effect on increasing lean meat and reducing fat trim in the carcass. Thus, the benefits from hormonal growth promoters accrue not only from increased growth rate but also from better feed efficiency and more lean meat in the carcass.

Romensin, since it acts to increase efficiency of digestion in rumen, does not affect carcass quality. Thus, the normal increase in fat and lean will occur in these animals.

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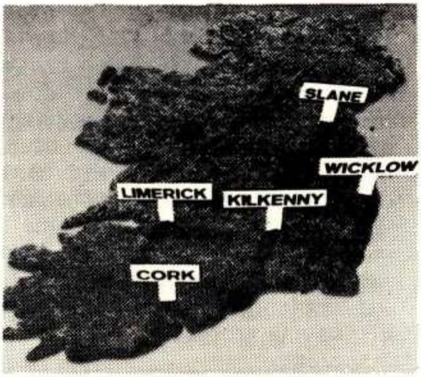

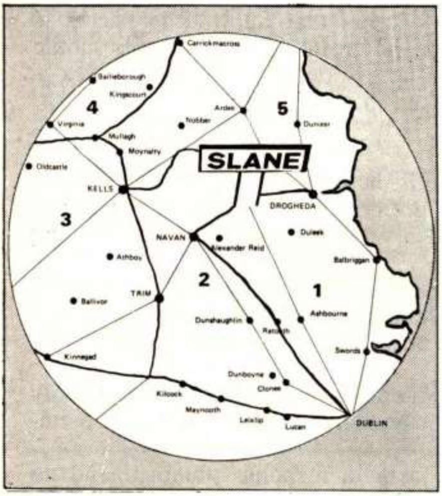

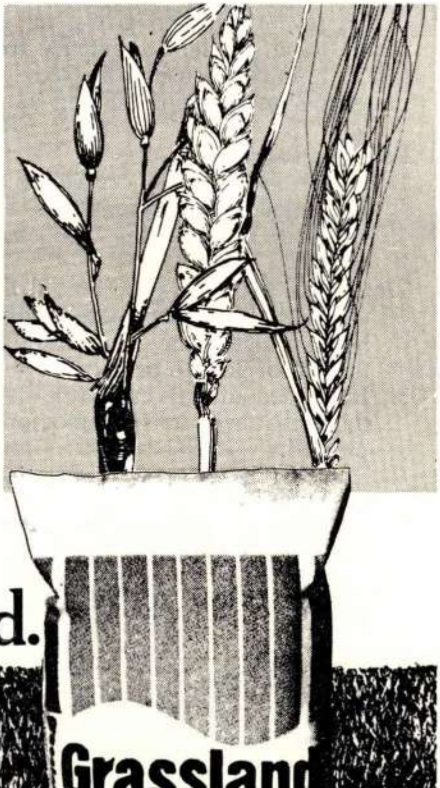

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Effects on behaviour

No undue side effects on behaviour have been reported following use of either Ralgro or Finaplix alone or in combination.

The use of oestrogen growth promoters such as Synovex has been associated with raised tail head, increased mounting behaviour and increased aggression. These behavioural effects generally last for 1-10 days but in extreme cases a small number of reports indicate effects lasting for 4-10 weeks. In some cases, size of rudimentary teats can be increased. To minimise these behavioural side effects, one should **avoid :**

i) crushing implant when inserting it;
;ii) implanting on wet days;
iii) having group sizes of implanted steers greater than about 40 in one area;
iv) mixing implanted steers with strange cattle.

If a severe problem arises, the few steers that allow other steers to mount them, should be removed from the group. These animals should not be re-introduced into the same group. In deciding to use Synovex-S, the effects on behaviour should be taken into account.

Points to consider

1. Under no circumstances should bulls, heifers or cows for breeding be implanted with hormonal growth promoters as they have deleterious effects on reproduction. Monensin is, however, safe to use in breeding cattle.
2. Growth promoters are an aid to good beef husbandry practices and not a substitute for good feeding and management. Animals should be on a high plane of nutrition in order to get maximum benefit from the use of growth promoters.
3. Implanted animals cannot be slaughtered for 65 days. Therefore, only those that will not be sold for at least two months should be implanted.
4. There is variation from farm to farm in response obtained and no clear explanation is available for this.
5. Implants are effective for 90-130 days. Thereafter, the animals will gain the normal weight as if they had not been implanted at all. As regards time of slaughter, the only limitation is to be sure the recommended withdrawal period has elapsed.

Conclusion on growth effects

An investment of £3 in growth promoters will give a return of £15 to £25 per animal treated, provided animals are on a good plane of nutrition. This is an important boost to profitability of beef production. However, use of growth promoters brings with it the added responsibility of ensuring meat from treated cattle does not contain undesirable residues of growth promoters.

Hazards to the consumer

A critical question is the possible hazard to the consumer when eating meat from implanted cattle. Let us consider the oestrogens.

(A) **The Oestrogens:** These can be classified as either steroids which are naturally occurring hormones, or non-steroidal synthetic compounds such as hexoestrol or diethyl stilbestrol (DES). In discussing safety, the distinction between naturally occurring and synthetic stilbene compounds is critical. Naturally occurring hormones : (i) are easily biodegraded to inactive compounds and are rapidly excreted in faeces or urine; (ii) have low activity when administered orally; (iii) do not persist for any length of time in the body.

In contrast, synthetic oestrogens : (i) are not easily biodegraded since they are foreign to the body and degradative pathways do not exist; (ii) have a high activity when administered orally; (iii) persist for longer in the body and thus are more potent.

Due to the fact that the synthetic stilbene oestrogens are more toxic and potent and persist for longer periods in the body, they should not be used for growth promotion in cattle. Instead, the natural oestrogens are the preferred products. The advent of new assay methodology called radioimmunoassay can now detect levels of hormones as low as 10^{-9} to 10^{-12} of a gram. This has then allowed us to examine the exposure of humans to natural sex hormones :

i) **Daily production rate:** Table 2 shows that daily production rates of oestrogens in humans are very high, depending on the particular physiological state. These hormones are present in the embryo shortly after conception and humans are exposed to them daily for the rest of their lives. The high amounts produced are rapidly broken down and are excreted continuously and are very high compared with the small amount present in meat from implanted cattle.

Table 2

Daily production rates of oestrogens in humans

	Production rate/day
Children	
Pre-puberal boys	30 - 40 μg
Pre-puberal girls	40-45 μg
Women	
Luteal phase	300 - 500 μg
Follicular phase	200 - 770 μg
Early pregnancy	1,000 - 4,200 μg
Late pregnancy	20,000 - 64,000 μg
Post-menopausal	30 - 50 μg
Men	
Intake from consumption of 10 oz steak from implanted steer	0.01 - 0.015 μg

ii) **Daily intakes:** Many common foods contain high levels of sex steroids and Table 3 shows that the levels present in milk or meat from pregnant animals is far higher than the level found in meat of a steer implanted with Synovex-S and slaughtered 61 days later. The hormone levels in meat treated cattle are low compared to those in certain other foodstuffs.

Table 3

Levels of oestrogens in normal dietary constituents of humans

Dietary source	Concentration of oestrogen
Milk from non-pregnant cow	80 pg/ml
Milk from pregnant cow	126 pg/ml
Meat from pregnant cow or heifer	2500-5500 pg/ml
Wheat germ	4000 pg/g
Soyabean oil	2000 pg/g
Meat from Synovex-S implanted steer (at 61 days)	22 pg/g

iii) **Natural sources:** Over 40 plant species contain oestrogens and sheep grazing *Trifolium subterraneum* pastures in New Zealand and Australia have a high level of infertility due to oestrogens. Soyabeans, wheat germ, lucerne, apples, cherries, potatoes, garlic and hops contain varying amounts of oestrogens.

iv) **Artificial sources:** Synthetic, orally active oestrogens are used by millions of women daily either as birth control pills or as hormonal replacement therapy to relieve post-menopausal syndrome. The daily quantities ingested are in the microgram range (10^{-6} gram).

Because of the high endogenous production rate of natural sex steroids by man and of the high daily consumption rate from normal constituents of the daily human diet, the use of natural hormones in beef production will have no significant impact on the total exposure of the consumer to steroidal hormones.

(B) **The Androgens:** The major male sex steroid being used for growth promotion is the synthetic steroid trenbolone acetate (Finaplix). This compound is very similar in structure to the naturally occurring hormone, testosterone. It has the anabolic effects of testosterone but does not cause secondary sexual behaviour such as mounting or aggression. Following insertion of implants of trenbolene acetate in the ear, the compound is released slowly over a 60-80 day period. The levels of trenbolone acetate in cattle slaughtered 60 days after implantation are lower than residues of testosterone in muscles, liver, kidney and fat. The major metabolite of trenbolone has a much lower biological activity than that of the parent compound.

Life-span studies in mice and rats show no abnormal pathology following its administration. Meat from cattle implanted with a normal or 25 times higher than normal dose of trenbolone acetate has been fed to rats. No treatment related toxicological effect was detected in the rats fed the treated meat, indicating that trenbolone acetate and its metabolites in cattle were not toxic in any way to rats.

(C) **Non-hormonal Anabolic Agents:** Resorcylic acid lactone (Ralgro) is a non-hormonal compound which increases the level of growth hormone in cattle. This compound has certain weak oestrogenic characteristics and whether or not it is an oestrogen is controversial. There are no detectable residues in meat in cattle slaughtered 60 days after implantation, down to the sensitivity of 0.1 ng/gram tissue. When given in high doses to monkeys, dogs and rats in life-time studies, no abnormal pathology has been observed. Thus, the available evidence to date suggests that it is a safe compound to use in animal production.

Problems

The major concerns in relation to public health arise from :

i) Use of undesirable products such as the stilbene synthetic oestrogens, e.g. DES.
ii) Misuse of "safe" or cleared products resulting in undesirably high residues in meat.

In relation to the first point, the stilbene derivatives should not be prescribed by veterinary surgeons or sold by pharmacists as anabolic agents. The naturally occurring oestrogens or resorcyclic acid lactone should be used instead.

As regards misuse of recommended products, this can arise from :

i) Inserting the implant in a site other than the ear. This should never be performed as there can be some unabsorbed compound at the site of implantation for periods of up to 6 months. If the implant is inserted properly in the ear, it will not pose a hazard to the consumer as the ear is discarded at slaughter with the skin.
ii) Slaughtering animals less than 60-65 days after implantation means that there can be high residues in meat. In order to ensure that there are safe or undetectable levels of residues, cattle should not be slaughtered until the recommended period of 60-65 days has elapsed.
iii) Using higher than the recommended dose.
iv) Injecting animals with androgens one to two weeks before slaughter. This injection is of no benefit and can result in high residues in meat.

Repeat implantation should be limited until the effect of repeat implantation on residues has been evaluated.

Conclusions on safety

The substantial evidence available at present indicates that the anabolic agents used in Ireland (Finaplix, Ralgro and Synovex), when administered as recommended, are safe and do not put the consumer at risk. It is essential that anabolic agents are used as recommended; misuse may lead to a total ban. Cattle should only be implanted after careful consideration of the important fact that they must be retained for 65 days before slaughter. Thus, it is necessary to consider factors such as, expected or unexpected changes in beef prices; degree of finish of cattle; expected selling date and amount of feed. Consumer protection from misuse of cleared products or from illegal use of undesirable products could be improved by (i) stricter control on their availability; (ii) routine random monitoring of meat for residues of growth promoters and condemnation of any carcass with undesirably high levels of residues as unfit for human consumption; (iv) educating people not to misuse them. The farmer, by proper use and adherence to recommendations, can ensure their continued use by not putting consumers at risk.

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Financing Intensive Beef Production

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The dismal returns from cattle farming in Ireland were highlighted once again in the recent Farm Management Survey Data which showed that farms classified as Mainly Dry Stock had a decline of 37% in income per farm in 1979 to £1,874 (1). The point has been made at previous Irish Grassland and Animal Production Association meetings (2, 3) that money can be made from cattle production in Ireland with modest technical input and poor live-weight gain per acre. However, such success in cattle trading is inevitably at the expense of some producer within the chain from calf-to-beef, and it would seem illogical that this should continue indefinitely. Present conventional wisdom is that serious cattle farmers must turn to more intensive systems requiring high technical expertise and output per unit area. This paper examines the economics of adopting several of the most widely recommended systems, some of whom are still in their infancy, in this country.

The following assumptions have been made :

(a) The farmer owns his land with no outstanding debt.
(b) All necessary buildings have been provided from farmer's own funds.
(c) Farmer has his own silage making equipment so that total control over silage quality is available.
(d) Home grown barley, storage and mixing facilities are available so that ration costs are £20/£25 per ton lower than the normal commercial rate.

In all three systems analysed, a high standard of technical performance is assumed; the sensitivity analyses indicate the implications for profitability when these standards are not achieved. A 60-acre farm unit was used throughout the exercise. The major assumptions for three systems are as follows :

1. **Calf-to-beef (24 month system)**

Stocking rate : 1 livestock unit per acre
Calf purchase price — £80 per head

Total variable costs (Year 1)	—	£84
Weight at 1 year old	—	275 kg
Total variable costs (Year 2)	—	£95
Weight at 2 years old	—	560 kg
Selling price @ £90/100 kg	—	£504/animal
Lifetime performance	—	0.75 kg gain/day

2. **Weanling-to-beef (2 y.o.)**

Stocking rate : 1.25 L.U. per acre
Weanling purchase price — £175 (190 kg approx.)

Variable costs (8-12 months) — £35
Variable costs (1-2 y.o.) as in calf-to-beef system (2 y.o.)
Weight targets/sale price — as in calf-to-beef system (2 y.o.)

3. **Continental-style 16-month old bull beef**

Stocking rate : 2 L.U. per acre (system conducted exclusively indoors on silage plus concentrates)
Calf purchase price @ £80 per head
Variable costs (0-6 months stage) — £68 per head
Variable costs (6-12 months) — £78 per head
Variable costs (12-16 months) — £93 per head
Sale weight—508 kg (285 kg carcase)
Sale price @ £95.25/100 kg — £484 per head
Lifetime performance — 1.0 kg gain/day

In the three systems a consistently low mortality of 1.5% was projected. Likewise, all systems were assumed to carry the same level of fixed costs (£2,200 p.a.) and living expenses £4,500 p.a.); an overdraft interest rate of 15% was assumed throughout.

Comparative financial evaluation of the three systems is on the basis of cash flow projections (Tables 1, 2 and 3) carried forward to the point of run-off on a permanent overdraft. The 24-month calf-to-beef system leaves a residue of £23,000 approximately after the first sale which can be converted to a term loan. This system would only break even after

Table 1

Investment profile : Calf-to-beef (24 month system)—60 acre unit

	Month 1	6	12	18	24
Calf purchase price 60 @ £80 per head	4800		4800		4800
Variable costs					
1	2460	2522	1121	4705	
2			2460	2522	1121
3					2460
Fixed costs		1100	1100	1100	1100
Living expenses		2250	2250	2250	2250
Borrowing requirements	7260	5872	11731	10577	11731
Interest @ 15% p.a.		465	870	1675	2455
Balance forward		(7260)	(13579)	(26198)	(38450)
Cumulative balance	(7260)	(13597)	(26198)	(38450)	(52636)
Sales					29736
O/D					(22900)

Table 2

Investment profile : 60 acre unit, weanling to 2 y.o. beef

	Month 8	12	20	24
Weanlings 75				
@ £175 per head	13125	—	13125	—
Variable costs				
Lot 1	2625	3200	4108	—
Lot 2	—	—	2625	3200
Lot 3	—	—	—	—
Fixed costs	1475	725	1475	725
Living expenses		1500	3000	1500
Borrowing requirements	17225	5425	24333	5425
Interest @ 15% p.a.		860	2000	2120
Balance forward		(17225)	(23510)	(49843)
Cumulative balance	(17225)	(23510)	(49843)	(57388)
Sales				37296
O/D				(20092)

Table 3

Investment profile : Continental style 16 month old bull beef—60 acre unit

	Month 1	6	12	16
Calves				
120 @ £80 per head	9600		9600	—
Variable costs				
Lot 1	7800	10620	11210	—
Lot 2			7800	—
Fixed costs		1100	1100	
Living expenses		2250	2250	
Borrowing requirements	17400	13970	31960	
Interest @ 15% p.a.		1110	2075	2830
Balance forward		(17400)	(32480)	(66515)
Cumulative balance	(17400)	(32480)	(66515)	(69345)
Sales				57112
O/D				(12233)

payment of interest on working capital and repayment of a 7-year term loan with no contingency buffer. The 24-month weanling-to-beef system is slightly superior due to more rapid stock turnover but any advantage would be highly dependent on maintenance of the projected weanling-to-calf pricing differential. The pay-back period would be reduced from 7.5 years (calf-to-beef) to 6.25 years (weanling-to-beef). The more intensive 16-month system with highest sales and most rapid stock turnover has a pay-back period of less than 3.5 years. However, this system requires the highest level of technical performance, assumes a sale price premium of £5.25/100 kg over the other two systems, and is more sensitive to price changes because of the additional stock numbers carried.

Margin sensitivity to changes in calf price, live weight gain, and selling price is summarised in Table 4. Whilst all systems are vulnerable, the 16-month system is particularly exposed if calves are over-priced and selling weight/price targets are not achieved. The sensitivity analysis over-simplifies the practical situation, where lighter animals could be unfinished (or even unsaleable) and unlikely to realise the projected top-of-the-market price. Such situations could arise from reduced inputs in ill-advised efforts to reduce costs; the co-efficients used in all three systems leave little opportunity for input reduction without impaired animal performance.

Table 4

Sensitivity analysis

Sensitivity factor	Change in margin Calf-to-beef (2 y.o.)	Weanling-to-beef (2 y.o.)	Calf-to-beef (16 mths.)
Calf price : ±£10 per head	£600	£750	£1200
Selling price : ±£2 per 100 kg	£660	£830	£1200
Selling weight : ±50 kg per animal	£2655	£3330	£5620

Total interest paid during the build-up period (Table 5) varies within the range £5/6,000 but interest charge per animal is almost halved in the 16-month system vs. the 24-month calf-to-beef system. A 5% cut in interest rate would increase surplus by £1,000 approximately in the 2 y.o. calf-to-beef system and by £1,500 approximately in the 16-month system during the build-up phase. Projected gross margins are shown in Table 6.

The levels of fixed costs (£2,200 p.a.)[a] and family living expenses (£4,500 p.a.)[b] may be criticised on the basis of (1) being too low, and (2) being charged entirely against the 60-acre unit when there is a clear implication throughout the exercise that a larger farm unit is envisaged to provide home-grown grain. Upward adjustment of one or both elements will extend the pay-back period.

Table 5

Interest charges during build-up phase (15% p.a.)

	Interest paid to 1st sale (£)	Interest/ animal sold (£)	Number of cattle sold
1. Calf-to-beef (24 month)	5465	92.6	59
2. Weanling-to-beef (24 month)	4980	67.3	74
3. Continental bull beef (16 month)	6015	51.0	118

Table 6

Gross margin

Systems	Gross margin (£)	
	Per animal	Per acre
Calf-to beef (2 y.o.)	240	240
Weanling-to-beef (2 y.o.)	192	240
Calf-to-beef (16 mths.)	151	302

Requirements/Advantages of intensive systems

1. More accurate, predictable planning of financial requirements.
2. Independent of more extreme cattle trading fluctuations.
3. High quality silage (68/70 D-value).
4. Excellent grassland management for 24-month systems.
5. First-class stockmanship.
6. Development of marketing arrangement which will ensure premium price for good quality animal supplied on a guaranteed basis.

Weakness/disadvantages of intensive systems

1. High capital investment especially for housing—in this exercise peak overdraft varied from £52,000 to £69,000.
2. Farmer requires own silage machinery to ensure quality control which further increases capital expenditure.
3. Margins sensitive to concentrate price so availability of home-grown grain is probably an essential feature of such systems tending to make them inappropriate for many small/medium sized farms.
4. Sensitive to calf price and interest rate especially during build-up phase.
5. Efficiency standards too demanding for average dry stock farmer.
6. Absence of guaranteed premium price at present for beef could mean significantly lower average return to the producer than budgeted in the paper.

7. Increased demand for autumn/early spring-born calves could increase price substantially.
8. Disease problems especially viral infections.

a Based on Farm Management Manual 1980, L. Connolly, An Foras Taluntais.
b Based on 1973 Survey of Rural Householders, adjusted for changes in C.P.I. since 1973.

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I wish to thank my colleagues Michael Madden for considerable assistance with the Cash Flow preparation and Maurice Keane for providing the Variable Costs Summary.

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Silage Quality and Milk Production

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Introduction

The importance of grass and forage crops in the feeding of livestock in the U.K. has been widely recognised (a.g. Food from our own Resources, HMSO, 1975). Estimates suggest that *c* 80% of the metabolisable energy (ME) requirement of the ruminant population is met from this source but for dairy cows the estimated contribution has only been in the region of 54 to 66% of requirement over the last decade. More detailed analysis of the winter period (Table 1) suggests that conserved forages supplied only 43 to 51% of winter ME requirement of the cow and this corresponded to 87 to 98% of maintenance energy requirement.

Table 1

Estimated contribution of conserved forages in winter diets (Friesian herds only)

	72/3	73/4	74/5	75/6	76/7	77/8
Winter milk yield (kg)	2212	2170	2255	2443	2441	2658
Concentrate (t)	0.94	0.89	0.95	1.03	1.12	1.14
ME requirement ('000 MJ)	22.1	21.9	22.3	23.3	23.2	24.3
Concentrate supply ('000 MJ)	10.3	9.8	10.4	11.3	12.3	12.6
Potential forage supply						
— '000 MJ ME	10.8	11.2	10.9	11.0	9.9	10.8
— % total ME required	49	51	50	47	43	44
— % maintenance ME requirement	95	98	96	97	87	95

Source : MAFF Dairy Management Scheme 1972-1978

Assumptions : 600 kg LW, 35 kg LW loss, concentrate 11 MJ ME/kg fresh weight

These estimates should be considered as the potential contribution of conserved forages, since a wide variety of purchased bulk fodders and fresh forage are used to supplement conserved forages on the farm in the UK (MAFF/ADAS, 1975). Further, estimates of the contribution of grass and forage crops derived from survey data must be treated with a great deal of caution since they are calculated by difference and include assumptions of cow live weight, live-weight loss and ME content of concentrates.

However, the data indicate little evidence that the contribution of conserved forage to the cow's diet has been increasing over the last decade despite the fact that the amount of forage conserved as silage has been increasing and also that the quality (ME, DCP) of this material is higher than that of hay. The objective of this paper is to examine some of the factors which can influence the contribution of silage to the diet of the dairy cow.

Digestibility of herbage

One of the major factors influencing the nutritional value of grass cut for conservation is the digestibility of the material at the time of cutting. The results of two experiments conducted at the GRI to investigate the influence of digestibility on milk yield are shown in Table 2.

Table 2

The effect of silage digestibility on intake, milk yield and consumption

	Trial 1		Trial 2	
D-value	57	64	62	72
Dry matter intake (kg/day)				
— silage	8.0	7.3	9.5	9.9
— supplement	6.3	6.3	6.3	6.3
Milk yield (kg/day)	18.7	18.4	24.8	27.9
Milk romposition (g/kg)				
— fat	33.0	33.3	41.0	36.1
— protein	29.8	30.0	29.4	31.5
— lactose	48.9	49.2	48.2	48.5

In the first trial (Tayler and Aston, 1976) the digestibility of the material had no effect on milk output since intake was lower with the silage of higher digestibility. This resulted from a poorer fermentation pattern of the higher digestibility silage. An additive consisting of equal volumes of formic acid and formalin was used in the second experiment (Thompson, Daley, Aston and Hughes, 1981). Little difference in fermentation pattern between the two silages was noted and earlier cutting resulted in a slightly higher silage intake, a higher milk yielid but a lower milk fat content. The achievement of higher yields through increased digestibility is possible but not consistently so as a result of variations in the fermentation quality of silage. Thus fermentation pattern is an important factor modifying the effect of digestibility and good fermentation is essential to realise the potential of higher digestibility silages.

Earlier cutting and increased frequency of cutting to produce higher quality material for conservation, however, results in a reduction in grass DM and often in digestible organic matter (OM) yield. The integration of milk yield and agronomic data is shown in Table 3.

Table 3

A simulation of the effect of cutting strategy on milk output

	Cutting systems			
	Very early	Early	Medium	Late
D-value	68	66	64	62
DM yield	10.7	14.9	15.9	17.2
Silage digestible* OM yield	4.4	5.9	6.2	6.4
Silage DM required (t)	2.27	2.13	1.79	1.66
Concentrate (t)	0.43	0.64	1.0	1.19
Hectares/cow	0.55	0.44	0.39	0.36
Milk yield (t)/forage ha.	10.0	12.5	14.1	15.3

Source : MAFF/ADAS (1976)

* Plot digestible OM yields reduced by 40%

The results indicate that the use of cutting systems to produce silages of relatively low quality resulted in the highest yields of digestib'e OM per hectare which combined with a higher concentrate input enabled a higher stocking density and higher milk output per hectare.

Thus, although cutting systems which produce high digestibility silage will allow an increased milk production per cow or a saving in concentrate input, they will often result in a reduction in milk output per grassland hectare. The extent of this reduction and the economic consequences will depend on grass growing conditions and the nature of the constraints on the individual farms. This all demonstrates that the choice of a cutting frequency is a vital one but also not a simple one. The interaction between output per cow and per hectare requires further investigation under different grass growing conditions and different systems of production.

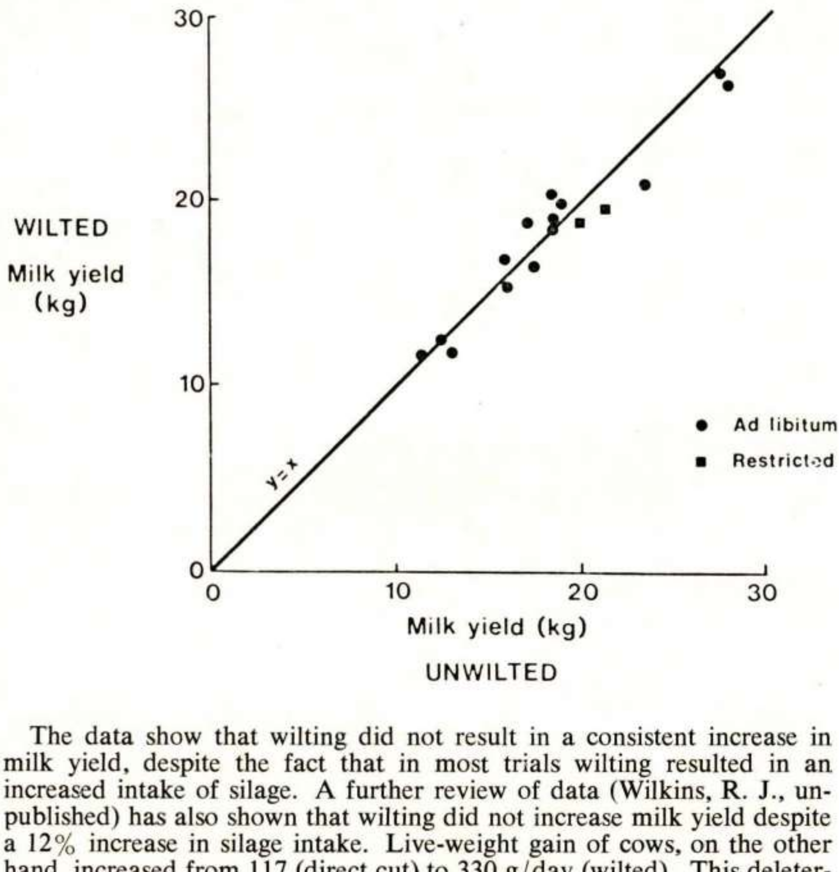
Fermentation quality

The objective of an effective conservation strategy is to produce silage of high intake characteristics which will result in increased milk production and reduction in losses. The aim is to produce silage with an ammonia-N content of $\lesssim$5% of total N, acetic acid of $\leq$2.5% of DM and with the absence of other volatile acids. The techniques normally used to achieve these objectives are wilting, additive and variation in chop length.

Wilting

The results of experiments which have examined the effect of wilting herbage prior to ensiling on milk yield are shown in Figure 1.

Fig 1 The effect of wilting on milk yield (n = 16)



The data show that wilting did not result in a consistent increase in milk yield, despite the fact that in most trials wilting resulted in an increased intake of silage. A further review of data (Wilkins, R. J., unpublished) has also shown that wilting did not increase milk yield despite a 12% increase in silage intake. Live-weight gain of cows, on the other hand, increased from 117 (direct cut) to 330 g/day (wilted). This deleterious partition of nutrients from milk into body-weight change and hence a reduced gross efficiency of utilization of wilted silage for milk production may be the result of a reduction in protein value on wilting (Beever, 1980). Recently, Gordon (1980) has shown a trend towards greater responses in milk yield to protein supplements with wilted compared to direct cut silage. The reduction in efficiency associated with wilting must, however, be balanced against positive managerial advantages such as reduction or cessation of effluent production and increased harvesting rate.

Additive

The results of experiments which have examined the use of a silage additive on milk yield are shown in Figure 2. Contrary to the data on wilting, the use of additive has resulted in a relatively consistent increase in milk production (+ 1.5 kg milk/day) mainly through an increase in silage intake rather than an elevation in digestibility. The additive used in the majority of these trials was formic acid but where comparisons were made of formic acid and acid/formalin mixtures little difference between the two types of additive was noted.

Fig 2

The effect of silage additive on milk yield

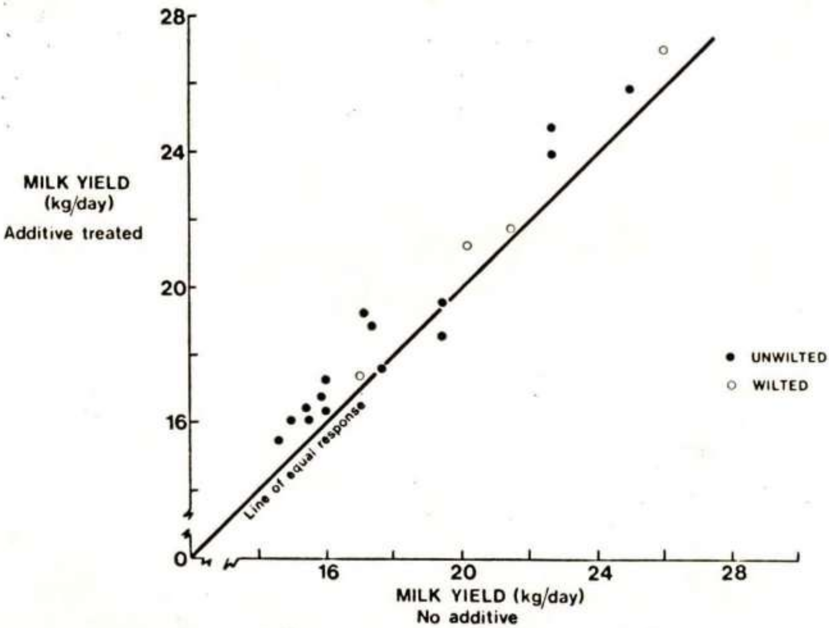


Table 4

Effect of chop length on intake and milk yield

	Chop length		
	Long	Medium	Short
Particle length (mm)	72	17	9
Silage DM intake (kg/day)	8.4	8.8	9.7
Milk yield (kg/day)	13.5	13.9	14.4

Source : Castle et al. (1979)

Chop length

Relatively little data are available on the effect of chop length on milk output but recent evidence from the Hannah Research Institute (Castle, Retter and Watson, 1979) suggests an advantage to short chopping (Table 4).

The cows were given relatively low levels of concentrate (2 kg/day) and the effect may be less marked at higher concentrate inputs. Also, the silages were given in troughs and it is possible that the differences could be magnified if the silages were self-fed.

Achieving the potential of silages

The data presented have shown that high levels of milk production can be achieved by cows given silage of high quality. The potential of forage can be maximised by feeding the silage to appetite. However, even if silage is given to appetite its potential will be restricted by the use of concentrate. Thomas (1980) showed that an increase in concentrate input results in a fall in silage intake. A value of *ca* 0.5 kg fall in silage DM/kg additional concentrate DM is commonly observed. However, with high basal levels of concentrate and silages of high digestibility, replacement values approaching 0.9 have been noted. In these situations additional concentrates result in only small increases in total energy intake but a marked reduction in the contribution of silage energy to milk production. Thus an effective conservation strategy must be coupled with an appropriate feeding policy if the potential of high quality silages is to be exploited. In particular, silage must be given to appetite and offered with low levels of concentrate.

The objective of the autumn-calving herd at GRI is to examine the potential of silage in a relatively simple system in which concentrate is given at a relatively low level and fed at a flat rate irrespective of milk

Table 5

Comparison of the performance of the GRI herd with that of the top 25% by gross margin of farms costed by the Milk Marketing Board's Farm Management Services (MMB/FMS)

	GRI	MMB/FMS
Yield/cow (l)	5800	5590
Concentrate use		
— t/cow	1.04	1.85
— kg/l	0.18	0.33
Stocking rate (cows/ha)	1.91	2.43
Fertilizer N (kg/ha)	330	290

yield. The results from the herd are compared in Table 5 with those of the top 25% by gross margin taken from MMB/FMS costed farms.

The GRI herd has a higher yield level than the recorded farms but, more importantly, a markedly lower input of concentrate. However, the emphasis on home grown feed has necessitated a lower stocking rate. Nevertheless the results show that good yields can be obtained with relatively low levels of concentrate input provided the potential of good quality silage is exploited.

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Where are We on Mastitis Control?

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Surveys on the incidence of mastitis in Ireland in 1963 (1) indicated that 47% of the dairy cow population were infected. The results indicated that most of the problem was sub-clinical and only 6.5% showed clinical symptoms. These results were similar to those reported from other countries at that time.

In 1978, a survey of 831 cows on 26 farms in the Cork liquid milk area (2) showed that 44% of the cows examined had mastitis. The number of cows infected on each farm varied from 7% to 90%. The predominant bacteria were *Staphylococci* (72%) and *Streptococci* (22%).

A more recent survey (1980) of 1753 cows on 37 farms in the Dublin liquid milk area (3) showed that 34% of cows were infected (herd range 12.6% to 88%). Again the predominant pathogens were *Staphylococci* (65%) and *Streptococci* (17%). When reviewing these survey figures, it could be concluded that mastitis control has not been very effective, particularly in some herds. It would appear worthwhile, therefore, to examine the development and effectiveness of control systems.

The control procedures developed and outlined over the years include, milking machine maintenance, milking hygiene, teat disinfection, antibiotic therapy (in the lactaton and dry period) and selective culling. These procedures were outlined mainly for the prevention of *Staphylococcal* infections but had questionable benefits in controlling environmental bacteria.

With the present increase in infections associated with environmental bacteria at calving, the efficacy of the whole mastitis control system is being questioned. These bacteria have presented farmers with a new set of clinical problems which are associated with poor winter housing, calving facilities, bedding arrangements, overstocking of yards and winter quarters. Research from Moorpark has shown that the problem is prevalent in both heifers and cows and that most of the infections develop between the onset of springing, and calving. The risk continues, however, while animals remain indoors.

It is important at this stage, to differentiate between sub-clinical infections generally associated with *Staphylococci*, older cows, and machine milking, and clinical infection associated with environmental contamination.

Development in the control of *Staphylococci*

Post-milking teat disinfection, now widely recommended, reduces new infection in lactating cows by 50%. Products containing 5,000 pmm available iodine, 4.0% available chlorine or combined chlorhexidine

(0.16%) and cetrimide (0.1%) were shown to be effective in experiments at Moorepark.

A new product, containing 0.3% w/v glutaraldehyde (Lactasep) as active ingredient was tested recently at Moorepark. The results showed that this formulation was more effective than iodine in preventing new infections (Table 1).

The reduction in new *Staphylococcal* infections in teats disinfected with glutaraldehyde was significantly lower than in those disinfected with iodine (Table 2).

Table 1

The incidence of new infection in two groups of cows disinfected with iodine or glutaraldehyde

Treatment	No. of new infections		
	Sub-clinical	Clinical	Total
Iodine (5,000 ppm)	19	12	31
Glutaraldehyde (0.3% w/v)	11	8	19

Table 2

Infection patterns in two groups of cows disinfected with iodine or glutaraldehyde

Infection type	No. of infections	
	Iodine	Glutaraldehyde
Staphylococcus aureus	26	12
Streptococci	2	5
Staph/Strep	1	1
E. Coli	0	1
Non-specific	2	0
Total	31	19

The results for glutaraldehyde did not show an advantage over iodine in preventing infections caused by environmental bacteria.

The role of antibiotics in mastitis control

Clinical mastitis must be identified and treated promptly. Correct selection and application of antibiotics is essential to maximise the response. Five commercial antibiotic preparations, for use in the lactating cow, were evaluated in 129 quarters infected with *Staphylococcus aurus*. The results are summarised in Table 3. The cure rates for these preparations ranged from 18% to 53%.

Results of further tests on a total of 58 *Streptococcal* infections (Table 4) showed responses ranging from 42% to 100% (only 3 quarters treated with Nafpenzal).

ORBENIN IN...

MASTITIS OUT!

ORBENIN

Orbenin Q.R. and L.A. contain 200 mg cloxacillin per syringe.
Orbenin Dry Cow contains 500 mg cloxacillin per syringe.
Orbenin is a Beecham Group trademark.

Table 3

Response of *Staphylococcal* infections to five antibiotic preparations infused during the lactation

Product	No of Treatments	Treatment interval (hours)	No. of infections	% response (cure)
Orbenin LA	3	48	29	39
Nafpenzal	3	24	50	18
Albacillin	3	24	22	27
Tetra-delta	3	24	17	53
Neo--Furamast-P	3	24	11	27

Two antibiotic preparations (Tetra-delta and Neo-furamast-P) are indicated by the manufacturers for broad spectrum therapy. Following the treatment of *50 Coliform infections*. cure rates of 73% and 83% were shown for Tetra-delta and Neo-furamast-P respectively (Table 5).

Table 4

Response of *Streptococcal* (*dysgalactiae* and *uberis*) infections to five antibiotic preparations infused during the lactation

Product	No. of treatments	Treatment interval (hours)	No. of infections	% response (cure)
Orbenin LA	3	48	12	42
Nafpenzal	3	24	3	100
Albacillin	3	24	11	64
Tetra-delta	3	24	14	93
Neo-furamast-P	3	24	18	66.6

The response to antibiotic therapy during the lactation is variable and depends primarily on; (i) the bacterium; (ii) the duration of infection; (iii) the active ingredient(s) and base used and (iv) method of application. The cure rate of *Staphylococcal* infections in these experiments was particularly poor, with wide variations in responses between preparations. Response was based on elimination of pathogenic bacteria together with a reduction in somatic cells for a period of $\geq$28 days after treatment.

Dry period antibiotic therapy

The poor response of *Staphylococci* to treatment during the lactation and the milk losses during treatment emphasises the need to treat these

Table 5

Response of *Coliform* infections to two antibiotic preparations infused during the lactation

Product	No. of treatments	Treatment interval (hours)	No. of infections	% response (cure)
Tetra-delta	3	24	15	73
Neo-furamast-P	3	24	35	83

Staphylococcal infections during the dry period. Previous results from Moorepark showed cure rates of 80-90% for infections treated at drying off. Recent studies, however, show that cure during the dry period is dependent on both the antibiotic preparation and the duration of infections before treatment. The results presented in Table 6 show a difference of 16% in response between Osmonds DC and Nafpenzal DC. The response for both these preparations, however, was between 33% and 17% lower than for preparations tested previously (4, 5).

Table 6

The efficacy of two 'dry cow' preparations in eliminating infections at drying off

Product	No. of infected quarters tested	% response (cure)
Osmonds	103	47
Nafpenzal DC	29	63

Environmental mastitis

Environmental bacteria are broadly classified as *Coliforms, Streptococci* and *Corynebacterium pyogenes.* Coliforms form part of the normal animal gut flora and may be isolated from soil, water and damp litter. A variety of *Streptococci* survive readily on the coat of cows and also in bedding materials. *Corynebacterium pyogenes* is widespread in our environment and can be isolated from open wounds, abscesses and some purulent uterine discharges. These bacteria present a constant challenge to our dairy stock throughout the winter housing period.

Teat disinfectants and antibiotics produce limited benefits in preventing environmental infection. Dependence on these control measures alone may produce disappointing results. The control of environmental infection requires special attention to hygiene during the dry period and particularly at calving.

Bedding

Comparisons of clay and concrete bedding at Moorepark showed that infection levels were higher in animals on concrete.

Table 7

The effect of clay or concrete bedding on the incidence of new intramammary infection

Bedding	No. of animals	No. of quarters infected	Percentage of quarters infected
Clay	156	81	13.0
Concrete	170	159	24.0

In these experiments, 13% of quarters of the animals on clay and 24% in the animals on concrete developed new infections. The pattern was similar for cows and heifers. The infections were predominantly clinical and primarily due to environmental bacteria. Further comparisons were made between concrete; concrete plus ground liemstone and concrete with the addition of mats and ground limestone. The results presented in Table 8 showed similar infection levels in both the limestone treated groups. The percentage of quarters infected in animals on the concrete beds was almost three times greater than in the other two groups. The addition of mats did not influence infection level.

Table 8

The incidence of new quarter infections due to environmental bacteria in cows on 3 bedding systems

Bedding	No. of cows	Percentage of quarters with new infections
Concrete + mats + GL	32	1.5
Concrete + GL*	32	1.6
Concrete	66	4.5

* GL — Ground Limestone

Discussion

Prevention is a fundamental concept in mastitis control, particularly since established infection is extremely difficult to eliminate. Teat disinfection has been one of the most successful procedures in the control of *Staphylococcal* infection. This technique will be most effective when applied after every milking and by following recommended procedures. Effective teat disinfectants reduce staphyloccal colonisation of the teat orifice which prevents establishment, and limits the duration of infection. Our experiments show that glutaraldehyde is a very effective teat disinfectant for preventing *Staphylococcal* infections.

When clinical mastitis develops, immediate treatment is recommended. Farmers may be confused, however, by the amount and variety of preparations available and the lack of precise treatment instructions on some packs. Some manufacturers claim clinical responses in excess of 80%. However, in our experiments on five preparations, bacteriological responses in staphylococcal infected quarters varied between 18% and 53%. The best overall response was obtained with Tetra-delta. When we consider that *Staphylococci* are responsible for 70-75% of mastitis problems some of these responses give serious cause for concern. The recent trends in formulating antibiotics for short persistence in the udder may also reduce cure rates.

The response to Nafpenzal was most effective during the dry period. This supports previous studies which indicated that higher cure rates were achieved with 'Dry Cow' preparations. The response to dry period preparations in recent experiments was lower than for preparations tested previously. The variation in response to lactating and dry period antibiotics highlights the need for efficacy standards on all products on the market.

Environmental infection is most prevalent at calving but the risk continues while animals remain indoors. Bedding materials play an important role in the aetiology of environmental infection. The degree of contamination on beds will depend on the following factors:

(i) the length of the bed;
(ii) the cleanliness of the dunging passages and yards;
(iii) the stocking density in the house.

Our experiments indicated that soft bedding materials were more desirable for bedding dairy cows. However, the addition of ground limestone to concrete beds reduced new infection levels.

Mastitis control must be a programmed development in herds over a period of time. Immediate benefits will not always be apparent but the implementation of a complete control system will produce the most effective results. Complete dependence on teat disinfectants and antibiotics without attending to the milking equipment, dry period hygiene and general hygiene during the lactation will greatly reduce the effectiveness of control. Studies are presently in progress at Moorepark to investigate management and herding systems for controlling infections. Additional research must also be directed towards greater control of environmental infections.

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Factors Affecting the Milk Price to the Farmer

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Introduction

In order to place the price of milk paid to the farmer into its proper context, and in order that we may correctly assess the effect of any other influencing factor upon it, it is necessary in the first instance to set down the scale of value over which co-operative managements have a degree of control. This area of control is influenced by the ordinary interaction of political, economic, social and climatic environments, each to a greater or a lesser extent. I wish, therefore, to review the functions related to the management of milk and dairy products directly under my control. As a point of clarification, I should define that milk price is defined as an ex farm gate milk price in the case of bulk refrigerated milk or a branch assembly point price in the case of milk delivered to a creamery.

Milk assembly

The 1970's brought about a dramatic change in the Irish Dairy Industry. The Common Agricultural Policy has meant that milk prices were increased to a level at which after 3 or 4 years farmers enjoyed a reasonable standard of living. For the dairy processing co-operatives it was a time of rapid amalgamation and increased capital expenditure to cope with the volumes of milk and to allow greater diversification. It was for the most part, however, amalgamation without rationalisation.

Over the last few years rationalisation of milk collection procedures have been undertaken albeit at a slower pace than would be desirable. In the case of Mitchelstown some 75% of the total milk supply is now assembled under the bulk system of collection as against 23% in 1973. The position is, however, that in those areas where branches were still operating alongside the newer bulk collection system, unit costs of assembly are effectively doubled for that area. Branch costs are relatively fixed so that when some of the throughput is diverted to the bulk system the total costs of the branch remain the same while the costs per gallon through the branch increase dramatically.

In Mitchelstown the net effect is that the price per gallon of milk is about 1p less for all milk than would be the case if a completely rationalised milk assembly system were to apply. The Society is rapidly moving away from the high cost labour intensive branch system and it is hoped that the assembly structure will be completely rationalised by 1/3/1983.

When examining the business of milk assembly within the co-operative and reorganising it so as to make the most efficient use of energy and transport, the areas of collection where different co-operatives overlap should be studied with a view to further rationalisation. Any saving, however, that may arise in this area will be minimal when looked as a percentage of total assembly costs. The volume of milk involved in such an exercise is not more than 10% of any co-operative's supply and the potential transport saving in moving this volume over a shorter distance to an alternative processing plant will be far less significant than is generally believed.

Composition of milk

When considering the Irish and other EEC milk returns we must take into account the relative yields and compositions.

In Ireland for the past number of years, culling of the national herd has occurred mainly on a disease basis, whereas the rest of the EEC has culled on yield. Also, less than 3.0% of Irish cows are milk recorded whereas in Holland over 62% of herds are now recorded. Table 1 shows the trends in milk yields, protein and butterfat contents in European countries during the period 1970-1978.

Table 1

Average milk yields and composition in European countries

Country	1970			1978		
	Gallons/ Cow	Protein %	Butterfat %	Gallons/ Cow	Protein %	Butterfat %
France	662	3.35	3.68	737	3.40	3.77
U.K.	840	3.30	3.85	1,024	3.30	3.84
Germany	812	3.30	3.80	922	3.35	3.85
Denmark	830	3.40	4.23	1,041	3.50	4.28
Holland	927	3.38	3.85	1,079	3.50	3.99
Ireland	537	3.28	3.57	695	3.20	3.53

EEC Dairy Facts and Figures 1980 MMB

The range of figures is also revealing. In Ireland, for instance, the average monthly proteins will range from 2.8% to 4.3%. In Denmark and Holland the range would be 3.3 to 3.6. Unfortunately, when the solids content of Irish milk is high, as for instance in November, volumes are low and with a butterfat of 4.8% and a protein of 4.0%, it is not possible to manufacture cheese or casein or other non-dried products. The average butterfat and protein contents during the manufacturing months of April to September would be 3.4% butterfat and 3.1% protein. The lactose levels of Irish milk at about 4.4% average are also much lower than the other EEC averages of 4.8% - 5.0%.

An important factor affecting milk yield and composition is mastitis. During the peak milk months Mitchelstown measures the cell count or levels of sub-clinical mastitis in each supplier's milk. The result is reported with the monthly milk statement and an estimate is made of the potential loss attributable to that supplier.

A survey of the results of 900 Mitchelstown milk suppliers carried out by our staff highlighted the effect of mastitis on milk yields.

Table 2

Annual average bulk milk cell count ('000/ml)

	Less than 250	250-500	500-750	750-1000	Greather than 1000
No. of herds	118	431	226	67	33
Average gallonage/cow	708	670	643	594	548
Loss in yield expressed as % of yield of lowest cell count group	—	—5.4%	—9.2%	—16%	—22.6%

Table 2 clearly indicates the loss that herdowners are experiencing in the various cell count categories.

The average gallon of Irish milk has a total solids content of 12.2% whereas in the other dairying countries such as Denmark and Holland the average gallon would contain 13.5% solids.

To see the effect of this, let us take the relative costs of drying one ton of skim milk powder in Holland and Ireland. Because of the lower contents of solids in Ireland, nearly 2200 lb of additional water has to be evaporated per tonne as against Holland, with a consequent increase in energy costs. The added labour cost, assembly cost and reduction in plant throughput consequent upon this factor are also quite significant.

In discussing the factors affecting the farmer's milk price the butterfat factor must be considered and I wish to comment on the butterfat testing practices. The Dairy Produce Act 1924 specifies quite clearly what one may or may not do. This Act was introduced to protect the interest of the milk supplier and a co-operative may not deviate from the requirements of that Act. I am satisfied that the controls and practices in operation at Mitchelstown are correct. Also, there is available within the Dairy Produce Act a facility whereby any supplier who so wishes can have his composite samples check-tested by the Dairy Produce Inspector provided he applies in writing to the Department of Agriculture and pays a fee of £2. This is a totally confidential service available to the supplier. The Creamery is never aware of a request having been made. The supplier is notified by the Department of the Inspector's result.

Seasonality

A product mix set out in the context of an annual production programme must recognise the seasonality factors that will affect production.

Further costs are incurred through the fixed capital requirements of a diary processor. A study carried out by the Dairy Industry Technical Study Group under the chairmanship of Mr. Michael Lovett shows the average plant utilisation of dairy plants throughout Europe. Bearing in mind that capital cost can only be justified when based on minimum payback periods of 2-3 years because of high interest costs and technical developments, we can easily see the effect of £1 million amortised over say, 80 million gallons of milk intake as being up to 0.42 p/gal. In Mitchelstown's case the reinstatement value of plant will demand a re-investment level of £3 million per annum at 1981 values, before added milk or technical development.

Manpower levels

A further difficulty arises in matching manpower operating levels to changes in the milk supply pattern and it has been quantified that up to 36% of total dairy wages are fixed in the manufacture of commodity products (Keane, 1980).

Market opportunities and intelligence should determine the mix of products a co-operative chooses to manufacture and, generally speaking, these will be ranked in order of preference, dependent upon the contribution that the milk content of the product will make to the fixed costs of the business.

We, in the past, have committed ourselves to markets which for a period of time did not yield an adequate return in the context of the alternatives available. It is not possible to say whether in the event that this situation were to arise again, we would similarly commit ourselves, especially in the long term. In my view the present margins available to us, having offered the price we have offered in the current year for milk, would not allow us to tolerate any loss-making operation. Anything that prejudices our return to the farmer through a net loss causes us to borrow money to pay for milk. This has the immediate effect of creating a burden on future milk supplies—a factor that no Board of Directors representing farmers and the interest of their society should tolerate. These factors reflected in a dairy processing society are principally :—

1. Finance and storage for working capital,
2. Investment for peak capacity,
3. Other operating expenses with a fixed oontent, which are reflected throughout the business from assembly through to market returns.

Diversification

The interaction of supply, demand and price for differing dairy products in different markets at different times also presents opportunities. The requirement to have adequate processing and labour facilities to optimise on such market changes is important. The cost of such facilities, which may not be used on a regular basis, has an influence on the level of investment required, together with its attendant cost.

In theory, the advantage from manufacturing a particular product should more than cancel out the extra cost involved. There are, however, some products which we are precluded from making because of the constraints imposed by seasonality. These are often compounded further because of the distance of Ireland from the market place.

Our major products are principally confined to milk powders, butter and hard cheeses—short shelf life products of which there are many on the Continent and which are good income earners are not technologically possible because of seasonality.

In 1980 over 80% of total manufacturing milk was processed into butter, skim milk powder and cheese. Butter oil and whole milk powder account for a further 15%.

Labour costs

Excluding raw materials, the cost of labour amounts to almost 43% of the total remaining costs in our dairying operation. It is a matter for regret that the dairy industry is not represented directly at National Understanding discussions and our influence, therefores on wage rates and the final form of any agreement is minimal.

The burden of Employers' Pay-Related Social Insurance surcharge also continues to rise and there is merit in the CII suggestion that this cost should be reduced from the present level of 10% to 3% (Confederation of Irish Industry 1981). Also, with such a vital content in the total value added there is no doubt that good labour relations will have a significant effect on the overall survival and growth of the industry.

Energy costs

Energy costs have increased drastically over the last number of years. The Society energy bill now exceeds £3 million and is increasing at an accelerating rate. The main influences are :

1. Increased prices by producer countries.
2. Currency surcharges.
3. Government tax and Irish inflation.

The fall of the Irish Punt, while not affording any advantage in the export of dairy products to the EEC countries, is certainly making our energy requirements more and more expensive. The Duty levied by the Government on fuel oils will cost our Society nearly £600,000 in 1981. Again, the Confederation of Irish Industries has made recommendations to the Government regarding this tax.

The Society at the moment is also considering the question of energy usage and a study of alternative cheaper forms of energy has been completed. Decisions are now being taken which we are confident will go some of the way towards offsetting the increasing burden of energy costs on dairy processing. People and energy costs account for over 60% of all value added in dairy processing.

Continued monitoring against standard and predetermined budgets, together with ongoing comparison of alternative energy sources, is a further important factor in offsetting rising costs. Indeed, a 10% volume saving in energy usage or labour hours would represent a major achievement for Mitchelstown Management, whereas a 20% + inflation index for each of these items is commonplace.

Remaining cost items, especially maintenance costs, can be treated in the same context as labour and capital expenditure whilst packaging materials are, largely speaking, hydrocarbon based and tend to increase at similar rates though somewhat later than oil price increases.

The view, therefore, relating to these items is that they will continue to increase in cost and that they do absorb a material proportion of the margin between value of finished products and milk price.

Cash flow

Cash flow is the first demand on the price of milk. It is the vehicle that sustains and develops the fabric of the Society to allow the Society to honour its commitment to its shareholders.

An adequate level of cash flow is necessary to justify the confidence that lending institutions and creditors have placed in the business—for each £3 invested in our Society £2 comes from sources other than owners funds and a cash flow must be of a level adequate to justify this commitment.

Marketing

Economic and geographic circumstances have created additional disadvantages for sellers of Irish dairy products on the international markets. In the first instance, our National inflation rate and wage cost increases have for a number of years substantially exceeded Brussels' declared product price increases. The effect of this, as already stated, has been to reduce the gross margin available to cover processing costs.

Secondly, distance from our market places an additional burden upon us in terms of shipment costs. These factors are further compounded by our seasonality of production—a topic which has been already covered. Together, they now offset, to an extent, what was often referred to as our distinct climatic advantages as a milk producing country.

With C.A.P. we have an intervention price structure which guarantees a minimum return on skim powder and butter. This effectively sets the minimum price at which milk may be incorporated into other producas.

The interaction of production and demand will determine the ultimate price to be achieved for such other diversified products.

We regard the foregoing cost elements as the principal factors within our scope of activity affecting the price of milk to the farmer.

We see some prospects for additional cost savings, principally in milk assembly and the overall vigilance of management in relation to operating expense. Also, to some extent these other costs will be contained by the emerging new technologies.

Seasonality of supply in all it implies, including capital investment, product mix, added working capital and productivity of labour among other things, remains with us and we expect, because of the advantage that farmers enjoy as producers of milk largely from grass, that it will continue to dominate our cost structure.

Whereas it is not directly within the scope of this paper, it would be quite incorrect to ignore the other areas related to the value of milk that may have an effect on its value to the farmer.

Inside the farm gate

It is necessary to point out as other authors have done recently (Raftery, 1981; Walsh, 1981) that the greatest scope for improving income from milk is still under the direct control of the farmer himself. Actual output per cow is far less than that which the experts say is achievable. With good grassland and dairy herd management an extra 100 gallons per cow would add approximately 7 p/gal on all milk produced.

In an effort to instil confidence and improve incomes, the Mitchelstown Society pioneered a cheap loan scheme for cow purchase. A loan interest subsidy is being provided by the Society which effectively means that the rate of interest paid by the farmer is fixed at 10%. This scheme is self liquidating for the farmer in that the income from the extra cows will more than repay principal and interest even in the first year. It is to be hoped that further schemes such as this will be introduced to stimulate investment and greater output, and restore confidence.

Conclusion

From the foregoing analysis it is clear that the potential for improved efficiency in the combined areas of assembly, processing and marketing, will not have as great an impact on milk prices as the potential still remaining within the farm gate itself.

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Managing Farm Finances in a Recession

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During the 1970's there was an unprecedented rise in prices for the main agricultural commodities and as a result, agricultural incomes rose substantially. Prices, however, plateaued in 1978 and cash surpluses were difficult to generate in 1979 and again during 1980. While the essential problems that caused the recessnon were stagnating prices and cost inflation, a series of other coincidences compounded their worst effects, as follows:

In 1979

(i) Poor grass growth in spring resulted in an increased usage of meals, e.g. lb meals fed/gallon of milk produced increased from 1.53 in 1978 to 1.76 in 1979 for a 700 gallon cow.
(ii) Substantial fall in cattle prices in autumn.
(iii) Acceleration of disease eradication measures.
(iv) Harvest losses.

In 1980

(i) Significant reductions in butterfat levels in milk, and calf prices.
(ii) Hay losses during the summer.
(iii) Harvest losses.

These developments also coincided with restrictions on credit as a result of Central Bank guidelines in the early part of 1979. However, by this stage many farmers' total borrowings had exceeded the limit which they could reasonably expect to service even in the long term. Meanwhile interest rates reached record levels and the increase in debt of farmers who had overborrowed accelerated once they became affected by the factors mentioned above. Table 1 illustrates the increase in loan repayments arising from higher interest rates.

Table 1

Loan repayment on £40,000

Term	November 1977	June 1980
5 year	£10,000	£12,000
10 year	£6,000	£9,000
15 year	£5,000	£8,120

However, most of these adverse conditions could have been overcome by the majority of farmers now in financial difficulty had product prices maintained their 1978 relative value.

Overall, therefore, while farm incomes dropped by about 40% in money terms between 1978 and 1980, the consequences on individual farmers has varied enormously. In general, all farmers experienced a drop in income from the 1978 peak. In the case of those farms which were being developed in the early 70's, the fall in income resulted in a greatly reduced cash surplus for saving and investment. However, for those who had begun to develop in the late 70's the recession was catastrophic, resulting in rapidly accumulating loan commitments. Thus, at this point in time many farmers are overborrowed to the extent that only asset disposal or massive concessions in interest rates or increase in product prices, will enable them to survive.

The problem of managing finances, therefore, takes on a different meaning and importance depending on which group is being considered. While most of our effort and concern must be for those farmers who cannot meet loan commitments or reasonable living expenses there is also some general advice which can apply to all groups. The proper or prudent management of farm finances is always important, recession or not, if one is concerned with increasing income and long term viability.

Farmers in severe financial difficulties

The problems being experienced by these farmers originated during the 'good' times of 1977/78. Many of them were virtually debt free up to about 1977 and took the decision to expand or modernise their farms, when they began to generate cash surpluses maybe for the first time. The majority were developing dairy enterprises and in many cases complete new facilities were required.

Many of th financial plans were marginal, even with 1978 margins and success depended on achieving a high level of efficiency. In many cases these farmers have now fully completed their building programme with perhaps only 75% of their stock targets achieved. Efficiency actually dropped on these farms during the first few years of development. This resulted in losses and a subsequent increase in borrowings. Some farmers can trace their present difficulties to excessive building or land reclamation costs. The total debt continued to build up almost un-noticed so that many farmers now have borrowings of between £700 - £1,200 per cow. The problem of split financing, i.e. money from many sources, contributed in no small way to this debt. All agencies seemed willing to lend without adequate study of the full facts. The farmer was solving his imediate cash problem by borrowing from a new source.

Whatever the reasons for past mistakes these farmers are in financial difficulty to varying degrees and must take action to improve the situation. They should seek assistance, give all available information, undertake a complete review of their present financial position and their prospects for the next couple of years.

Possibilities available

(1) The most immediate and satisfactory method of easing the present problem is by restructuring of loans. Many of the cases can be solved, at least in the short-term, by that simple expedient which the lending institutions will grant without much difficulty. In certain cases, the impact can be dramatic as shown in Table 2.

Table 2

Restructured loans on 50 acre farm with 34 cows + replacements (IR£)

	Present loans outstanding	Term (years)	Annual repayments	Proposed	New repayments
1	6,286	5	2,028	15 yrs	1,172
2	2,002	14	318	no change	318
3	2,500	5	820	15 yrs	465
4	2,803	10	734	no change	734
5	6,565	7	1,848	15 yrs	1,221
	20,156	Total	5,748		3,910

In this example there is a reduction of over £1,800 in annual repayments which will make the difference between breaking even and accumulating unpaid interest, even at slightly higher interest rates.

For large loans the effect is of more significance as shown in Table 3.

Table 3

Effect of restructuring a loan on repayments (IR£)

Present repayments		Restructured	
£50,000 — 7 yrs	£12,100	15 yrs	£9,000
£25,000 — 5 yrs	£7,500	15 yrs	£4,500
	£19,600		£13,500

Reduction of £6,100 in annual commitments

(2) **Improve efficiency**

An immediate problem on most farms, particularly those in financial difficulties, is to improve efficiency. In many cases efficiency has suffered on those farms over the past few years due to pressures of various kinds. The very fact that development is going on means that the farmer cannot devote his full time to managing the enterprises and where he attempts to reduce investment costs by using own or direct labour, the general level of efficiency can drop seriously. In one recorded case, yield per cow dropped from 750 gallons in 1977/78 to 500 gallons in 1979 and 1980. The potential for improving yield and general efficiency is enormous on many farms. However, it may require 2-3 years to improve efficiency sufficiently to meet commitments so a moratorium on principal may be necessary for some time.

Many farmers who are presently experiencing difficulty in meeting repayments can alleviate their problem by improved yields. This improvement can be initiated on all farms immediately. Simple management control systems can be set up if necessary on these farms to monitor progress and control performance.

(3) **Increase size of enterprise**

On many farms in financial difficulty, especially dairy farms, the livestock targets have not been achieved. Indeed some have only 50-70% of their potential or planned numbers even though buildings and facilities are completed. For those farmers, expansion to their original targets is essential especially where tillage is not an option.

(4) **Sale of assets — land**

In some cases where the farmer is totally over committed (£1,000 + per cow), no restructuring or long term improvements will solve the problem. As the situation continues to worsen the debt accumulates and over 5-6 years the original debt could be doubled. In such a case the options are very limited and the disposal of some assets to reduce debt must be considered. The sale of sites is the easiest way of reducing commitments and still maintaining the full potential of the farm. Where the sale of sites is not possible or sufficient to solve the problem then the sale of some land must be considered. Where an outfarm or small section of land can be sold without affecting the long term viability of the farm then this course of action must be considered. Farmers who purchased land in 1977/78 and are now £1,500 or more per acre in debt may have no option but to sell part of the purchased land. Of course the sale of land would only be considered after all other courses of action are exhausted.

(5) **Sale of livestock and substitution with tillage**

Some farmers are being advised to sell livestock even where tillage is not an alternative, to reduce their commitments. This "advice" is short-sighted and dangerous as in most cases the remaining debt is still much too large for the new situation. The possibility of selling off low yielders and substituting with tillage, using contractors for all operations would be of some advantage provided that :

(i) tillage yields are high;
(ii) no extra machinery is purchased. However, the tillage alternative must be treated with caution as it can lead to large investment in machinery, and very often yield does not reach expectations.

(6) **Moratorium of interest**

At present some lending institutions are deferring interest payments for a year or so in the hope that conditions will improve. This concession is useful to farmers who have to make further expansion in stock numbers and/or have potential for greater efficiency as it gives them more time to consolidate their enterprises. However, the farmer should satisfy himself that this deferral of interest will in fact give him a better chance for success, as many farmers may find themselves with greatly increased debts and no capacity to meet repayments. If asset disposal is necessary, it is better to know immediately and be prepared to avail of opportunities for high sale prices, than in later years when good chances may have been missed.

Cash flow budgets give a reasonable indication of current finances.

(7) **New investments**

New investments in buildings, equipment, land reclamation, etc. should be considered with great caution and in some cases should not be made.

In cases of severe financial difficulties, investment in fixed assets must be minimal and only for absolutely essential items which give a quick return. The cost of the investment must be rigidly controlled and kept within the budget.

For young farmers with small to medium size farms with a lot of development potential, productive investment must come first. Investment in modern expensive buildings and equipment must be postponed until stock numbers are increased and their management has reached acceptable levels. A high level of commitment should not be confused with management ability. These farmers must first prove their ability (especially to themselves) and work with cheap functional buildings until matters improve financially.

For those farmers who have achieved high levels of management and have small borrowings, a recession is probably the ideal time to take advantage of their relatively strong position in the market to modernise and install facitities. In all cases, however, the advisor should be consulted and a realistic farm plan with cash flow or annual budgets prepared.

Lessons to be learned by developing farmers

From the events of the last few years there are a number of lessons to be learned, especially by farmers about to commence development :—

(1) Agriculture is a cyclical industry and the "good" year should be treated as compensation for the "bad" year in the past or future. Plans or budgets should therefore be prepared on long term realistic prospects for the enterprise.

(2) Where borrowed money is likely to be required, a financial plan should always be prepared.

(3) When incomes are high the term of loan could be shortened so that there is flexibility to restructure if incomes fall.

(4) Beware of using current cast flow surpluses for financing major investments, only seeking loan facilities when spare cash runs out. Very often repayment capacity does not exist.

(5) Keep within budgets and loan approvals. Many farmers currently in trouble greatly exceeded their original budgets. Use the farm plan, physical and financial, as a reference document to guide and control development. Wrongly, the plan or cash flow is often discarded once loans are approved.

(6) Beware of Hire Purchase as they are too expensive and too rigid when income falls.

(7) If overdrafts for working capital cannot be paid off within the year, recognise this as a problem, not to be concealed by applying to another agency for finances to keep the operation working.

(8) Know the minimum efficiency targets which are required for success.

If targets must be high then set up a recording system to monitor and conrrol the important factors which determine yield, efficiency, etc. In general, farm management accounts have often been abused and ignored.

(9) Arrange loan repayments to suit expected cash flow surpluses.

Management of current finances

After discussing the structural aspects of managing farm finances, let us now examine the more immediate problems which every farmer considers in a recession. Again, the pressure to take action will vary with the different types of financial problems.

When incomes fall and living costs increase, the most immediate reaction is to reduce costs. This can vary from the elimination of waste to a drastic cut back in vital direct inputs, fertiliser, feed, etc. How can the farmer reduce his costs and at the same time maintain his production and increase income ?

1. **Overehad costs**

There are a number of overhead costs which can be investigated. Machinery running costs should be examined in particular. Many farmers, accustomed to buying diesel at 10p per gallon have not adjusted to the fact that it now costs over 84p. Many unnecessary journeys are made each day on nearly all farms carrying small loads or merely as a means of transport. In operating machinery for essential operations, Table 3 demonstrates significant potential for saving in fuel costs for the heavier power consuming operations.

Table 3

Potential savings in fuel costs (McCarthy, D. and Fitzgerald, Gerald L., A.C.O.T., Athenry)

Item	Diesel consumption gals/hour		Gallons saved/day	Saving per day (£)
	Poor servicing	Good servicing		
Faulty injectors (heavy work)	4½	3	12	10.08
Incorrect clearances (e.g. baler)	3	2	8	6.72
Blunt knives (e.g. precision chopper)	4½	3	10	8.40
Wheel slip (e.g. ploughing)	4	3	8	6.72
Yard transport (large tractor v small)	2½ (90 H.P.)	1½ (45 H.P.)	5	4.20

The following steps can be taken to reduce the above costs :

(i) Set out the injectors and check fuel injection pump output every two years (cost £20 - £30).
(ii) Set up machines correctly.
(iii) Sharpen the cutterhead on precision chops twice daily
(iii) Sharpen all knives and flails properly on forage harvesters. Sharpen the cutterhead on precision chops twice daily.
(iv) Place wheel weights on when ploughing and remove when tilling.
(v) Use a small horsepower tractor for yard work and use a high horsepower tractor for the large machines. It is not unusual to find large tractors on grassland farms even though contractors are employed for sialge making, etc.
(vi) Repair all leaks.

Similarly, car and electricity expenses which cost a minimum of £1000 cash per year even on small farms can be curtailed.

In the relatively simple area of milking machine washing, Table 4 shows that savings up to £350 in electricity costs are possible by switching from boiling to cold circulation cleaning.

Table 4

Variation in electricity costs between different washing systems (IR£)

	6 unit parlour		10 unit parlour	
	Cost/day	Annual cost	Cost/day	Annual cost
Cold circulation	24p	72	40	120
Acid/boiling water	96p	288	160	480

Finally, maintenance or miscellaneous fixed costs should be examined. Many hundreds of pounds can be spent annually in beautifying and maintaining the farm, e.g. extra concrete, new fencing, gates, etc. Some of these items can be postponed for a few years without unduly affecting farm performance.

(2) **Living expenses**

In times of severe financial difficulties living expenses must be kept under control. While excessive living costs are only a problem in a minority of cases there is still scope for savings on some farms without causing hardship. In a farm situation it can be difficult to control living costs. Thus, it is advisable to open a separate household account to which regular agreed transfers can be made. This makes control and budgeting easier.

(3) **Savings on variable or direct costs**

It is much more difficult to reduce costs in this area without seriously affecting yield or general efficiency. The aim here must be to cut expensive inputs by direct substitution with cheaper products. For example, in calf rearing many farmers feed all whole milk for the first two months.

Substantial savings can be made by using milk replacer instead of whole milk and by weaning on to concentrates and hay at a younger age. Savings of between £6 to £20 per calf are possible on many farms.

The other items which should be examined are meal inputs and fertiliser applications. In general, rate of fertiliser application seems to be somewhat below recommended levels at various stocking rates. This results in an increase in meal inputs to substitute for grass. Moorepark results have shown that for every pound of nitrogen applied for early grass, dry matter production is increased by 9-15 lb or up to 150 lb fresh grass. Depending on the economics of the day substituting urea for CAN can reduce costs without reducing nutrient input. In most grassland situations it should be possible to use 50% of total nitrogen required in the form of urea.

Good grassland farmers and managers can achieve 800-900 gals of milk per cow with under 1.0 lb meal per gallon. However, the average is about 1.5 lb/gal. The difference amounts to 4 bags per cow valued at £30 per cow.

On a general basis the cost of finance can be trimmed by avoiding too much Co-op or merchant credit. Some agencies charge up to 2½% interest per month which is well over 30% for the year. Whilst it is attractive to buy now and pay later, the loss of a 5% discount and paying even 1½% per month for 6 months is equivalent to a yearly interest charge of over 28%. If possible, finances should be arranged so that all working capital requirements are financed on overdraft. This overdraft should be paid off within the year if possible, in order to avail of lower interest rates.

Where finances are extremely limited and where the control of input costs is a problem, a monthly or quarterly cash flow budget should be prepared and used monthly or quarterly to monitor and control performance. Adequate management accounts are also essential but often seem to be ignored.

Whilst there is professional help and advice available to farmers with financial problems, it is the job of the farmer to farm and change matters. Waiting for outside help or price rises can be a costly exercise especially when there is so much scope for improvement on many farms.

A Technical Economic Comparison Between French, British and Dutch Dairy Farms

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In November 1978 in Versailles a meeting was held on the question : What is the relative farm economic position of dairy farmers in France, the United Kingdom and the Netherlands. This meeting was organised by "l'Association Française pour la Production Fourragère". The Association had invited an English, a French and a Dutch research worker to present data on dairy farms from their own countries. During the previous provisional meeting agreement was reached about a uniform presentation. Moreover, it was decided to give a detailed picture of a few dairy farms instead of an overall picture of the average situation in the whole country. There is a very wide variation from farm to farm and from area to area. The average does not give a good idea of the potential possibilities and the data are not suitable for a deeper technical analysis. Therefore preference was given to choosing two or three dairy farms which could be considered to be representative of the top third of the total number of farms in an important dairy area in the different countries. Criteria for this were income and milk production per cow. Finally a comparison was made between 3 French (Brittany, Normandy, Lorraine), 2 English (Shropshire, Dorset) and 2 Dutch farms (N. Brabant, Utrecht). In the scope of this article the presentation of the figures will be restricted to one farm from each country.

The farm plans

On the French farm wheat and barley are grown (Table 1) and fodder production is varied. Besides grassland, kale and fodder maize play a role. The English farm is the largest and in keeping with the total picture in this country. The French farm keeps a rather small herd in a stanchion barn. The barn has been modernised and a milk tank is available. On the English and the Dutch farms the cows are kept in a cubicle house. On the French and the English farm there is a large herd of young stock while on the Dutch farm replacements are minimal.

The English farm has some hired labour, the other two are pure family farms.

Technical productivity

Labour productivity is lowest on the French farm, even when the cereals are taken in account (Table 2). Between the other two farms, the difference is not large.

Table 1
Farm plans

	Brittany	Dorset	N. Brabant
Land (acres)			
Cereals	10.00	—	—
Grassland	48.13	140.75	62.13
Fodder maize	15.63	—	10.00
Kale	6.25	6.25	—
Total area	80.01	147.00	72.13
Cattle			
Dairy cows	32.9	83.0	73.7
Livestock units	46.7	125.2	94.1
L.U./dairy cow	1.42	1.51	1.28
Labour			
Farmer	1.0	1.0	1.0
Family	0.6	0.6	0.6
Hired labour	—	0.6	—
Total of fully employed labourers	1.6	2.2	1.6

Table 2
Technical productivity

	Brittany	Dorset	N.Brabant
Labour			
Dairy cows/fully employed labourer	21	38	46
Livestock units/fully employed labourer	29	57	59
Land			
Forage acres/livestock unit	1.50	1.17	0.77
Kg N/acre of grassland	74	108	191
Kg D.M. forage/cow/day (winter)	13.0	9.0	9.5
Kg concentrates/cow/year	610	1235	1655
Purchased fodder in % of total fodder	11.5	26.1	42.6
Net S.E. production/acre*	1585	1673	2415
Dairy herd			
Kg milk/cow	5534	5315	5907
Fat content	3.80	4.00	3.90
Protein content	3.00	3.26	3.22

* Estimated

Land use is vxery intensive in the Dutch farm. Stocking rate and nitrogen use are highest, resulting in the highest net SE production per acre. Due to the very high stocking rate, production from the farm itself is not sufficient and much feed stuff must be purchased. This is mainly concentrate but also roughage is bought. Home produced fodder on the Dutch farm is only 57% of the total fodder consumed, whilst on the other farms it is respectively 88% and 74%. The high proportion of purchased fodders is typical for the Dutch dairy industry. The shortage of land brought the Dutch dairy farmers first to an intensive use of their own grassland and further in connection with a relatively favourable ratio of milk price and concentrate price, to a high level of purchased fodders. The English farm occupies a middle position.

Milk production per cow is relatively high in each farm. The good production on the French farm is striking in relation to the low concentrate level.

Price ratios

Table 3 gives some prices of products and production inputs in the different countries. These are general price data of the regions and not the actual prices of the three farms. In the Netherlands we find a relatively high milk price and a favourable milk price—concentrate price ratio. However, wages, prices of machinery and land prices are very high. In the United Kingdom, milk price is lowest and the prices of calves and cull cows are very low.

Table 3

Prices 1977/1978 (£ = Hfl. 4.71 = Ffr. 9.42)

	France	United Kingdom	Netherlands
100 kg of milk	10.61	9.50	12.73
1 calf (female, 8 days)	95	53	70
1 in-calf heifer	548	460	403
1 cull cow	361	268	318
1 kg N	0.23	0.21	0.28
1 kg concentrate	0.11	0.09	0.11
Wages herdsman/year	5670	4030	8360
Wages mechanic/hour	3.40	6.15	6.37
Tractor 60 h.p.	5720	6000	8100
Rent 1 acre of land	18	19	34
Purchase of 1 acre of land (free of rent)	800	1100	3400

Financial results

Technical data and price ratios together give the financial results. Table 4 gives the calculation of the net profit. The labour of the farmer and his family has been taken into account in calculating costs. Interest on the total investments (the farmer's own money + borrowed money) in cattle, machinery and buildings has been calculated at 8%. The costs for the land have been worked out on a rent basis.

Table 4

Financial results

	Brittany	Dorset	N. Brabant
Returns			
Milk	16477	42167	53086
Cattle sales	6341	6342	12297
Other returns	2652	152	1291
Total returns	25470	48661	66674
Labour	8505	9636	13494
Contractor	731	646	2592
Machinery	2608	4694	5580
Purchased feedstuffs	2721	13467	16034
Fertilisers	1843	4312	3605
Other direct costs	2989	4075	5553
Land (rent)	1358	2807	2449
Buildings	2046	4968	7361
General costs	1922	2271	2920
Total costs	24723	46876	59588
Net profit	747	1785	7086
Labour income	9252	11421	20580
Labour income/fully employed labourer	5782	5191	12862
Cost price per 100 kg of milk	8.64	9.16	10.57

Net profit from the Dutch farm is highest. Compared with the other farms the total production is raised to a high level by intensive land use (nitrogen), purchases of concentrates and roughages and a high milk production per cow. This, in the Dutch price situation, has led to a high gross margin per acre and per farm. The gross margin/acre was £573 compared with £206 on the French and £184 on the English farm. A high gross margin was combined with a high labour productivity. In spite of the high labour productivity (59 L.U./FEL), labour costs are high because wages are very high. Together with high costs of contract-work machinery and buildings this makes the sum of these costs very high. Per L.U. this sum is £308 on the Dutch farm and on the French and English farms it is respectively £297 and £159.

Compared with the French farm, the Dutch farm achieved its better result by means of its better structural and technical performance. An analysis of price and technical influences showed that the French price climate as a whole was a little more favourable for milk production than the Dutch. The English farm had a lower result than the Dutch both because of a slightly lower technical level and a less favourable price climate. In particular low cattle prices play a role.

Finally it must be stated that the Dutch farmers in their price situation (high wages and high costs of land together with other high prices) are forced into very intensive farming. This situation is very vulnerable to changes in the prices of concentrates, nitrogen and fuel. In these times of increasing energy prices, this situation is not without its dangers.

THE EFFECT OF LEVEL OF SOIL CONTAMINATION ON MACHINE-WASHED HERBAGE SAMPLES

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The effect of machine-washing herbage samples contaminated with known levels of soil was evaluated. Soil contamination levels were 0, 10 or 20 g of dry soil per 100 g of green herbage. Within each soil level samples were either not washed, or washed for 2 or 4 minutes. All samples were dried, ground and analysed for ash and *in vitro* dry matter digestibility (DMD) and organic matter digestibility (OMD).

The dry matter (DM) content of unwashed material was positively ($P<0.001$) related to the level of soil contamination, whereas that of washed herbage was negatively ($P<0.001$)) related. The DM content of uncontaminated herbage was not influenced by washing, but when contaminated, the DM content of unwashed material was significantly greater than that of washed material. Duration of washing was only significant at the 20 per cent level of soil contamination. In unwashed material, there was a significant decline in the organic matter (OM) content, and an increase in the ash content, as soil level increased, but the OM and ash contents of washed herbage were similar for all soil levels. The OM and ash contents of uncontaminated herbage were not affected by washing, however at the 10 and 20 per cent soil levels, washed herbage had significaitly greater OM and less ash contents than unwashed herbage.

The DMD coefficients of unwashed samples decreased ($P<0.001$) with increasing soil level, but were equivalent in washed samples for all levels of soil contamination. Similar results were apparent for the OMD coefficients.

Washing resulted in important losses of herbage DM, predominantly digestible DM and organic in nature, only when the material was contaminated. These losses increased with increasing level of soil contamination.

It was concluded that the machine washing of herbage samples was effective in eliminating soil contamination without affecting herbage *in vitro*.

EFFECT OF SWARD COMPOSITION ON PRODUCTION

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A number of trials have been carried out over the past few years to examine the effect of sward composition on production.

Sward dry matter yields in the first two years of a new ley were not affected as the meadowgrass component of the seeds mixture increased to 40% by weight. Animal production under grazing was similar from swards containing high (over 40%) and low (less than 20%) levels of perennial ryegrass.

Total dry matter yields were not affected by using mixtures of perennial ryegrass varieties rather than one variety. However, there were differences in seasonal production from the different mixtures. Increasing the Italian component of the seeds mixture from 0 to 33⅓% by weight tended to increase dry matter yields in the first two years of the ley.

THE EFFECT OF WILTING ON THE EFFICIENCY WITH WHICH SILAGE DRY MATTER IS USED FOR BEEF PRODUCTION

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Three groups of Hereford X Friesian steers (10 per group-initial weight 464 kg) were fed direct cut silage (22.7% DM, pH 3.89), medium wilted silage (31.3% DM, pH 4.48) and heavily wilted silage (39.7% DM, pH 4.69) for 119 days. A fourth group of animals was slaughtered to estimate initial carcase weight and composition.

Grass was harvested from a mainly perennial ryegrass sward with a precision chop harvester on May 22-26, 1980. All grass was of high quality and was treated with 2.3 l/tonne of 85% formic acid.

Animals were individually fed silage *ad libitum*. Average daily DM (toluene) intakes were 8.99 kg, 8.63 kg and 9.91 kg per day; daily live-weight gains were 0.89 kg, 0.74 kg and 0.94 kg/day and daily carcase gains were 0.58, 0.45 and 0.47 kg/day for direct cut, medium wilted and heavily wilted silage, respectively. The efficiency of utilization of ingested silage DM for carcase production was 15.66, 19.91 and 21.85 kg DM intake/kg carcase gain for direct cut, medium wilted and heavily wilted silage, respectively.

THE EFFECT ON BEEF CATTLE OF PREMIXING ROUGHAGE AND SUPPLEMENTS

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The voluntary intake and performance of crossbred Friesian steers offered silage only or silage and 2.41 kg barley dry matter per day which were either fed separately or in a homogenous premixed form, were measured. A total of 30 individually stalled animals were used in the experiment. Supplementation with barley resulted in increased total dry matter intakes in both methods of feeding but the increase was only significant where the supplement and roughage were premixed. The supplement caused a significant decrease in silage intake in both methods of cereal presentation but the reduction in intake was significantly less where silage and supplement were blended into a balanced complete feed. Differences in animal performance between the treatment groups were closely associated with the level of feed intake. Supplementation with barley improved daily live-weight gain and mean carcass weight but this improvement was only significant for the animals fed the premixed feed.

Possible reasons for the improvement in animal performance and voluntary intake were discussed.

CONCENTRATE SUPPLEMENTATION FOR AUTUMN CALVING DAIRY COWS

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To determine the optimum level of concentrate supplementation for cows during the winter period requires a knowledge of the relationship between concentrate input and milk output. The purpose of the present trial was to establish this relationship for autumn calving cows having access *ad libitum* to grass silage. In the experiment a total of 140 British Friesian cows were used, over a three-year period, in a randomised block experiment to examine the effects of feeding five concentrate levels of 636, 888, 1140, 1378 and 1586 ± 10.3 kg concentrates during the winter period. The cows calved from late September to early December and had a mean calving date of October 27.

All concentrates were offered in two fixed steps during the lactation with the intake during the first 100 days of lactation being 2 kg/day above that given during later lactation. In addition, all animals had access *ad libitum* to grass silage with a mean dry matter content and D-value of 218 and 670 g kg^{-1} respectively. Sixteen replicates per treatment were housed in individual stalls for measurement of silage intake while the remaining replicates were housed as a single group in each year. At pasture all animals grazed as a single group without supplementary concentrates. Increasing the level of supplementation reduced silage intake and increased milk yield during the winter, with the silage intakes being 1802, 1738, 1666, 1641 and 1581 ± 41.0 kg DM and winter milk yields being 3413, 3586, 3885, 3986 and 4052 ± 49.5 kg per cow for treatments 1-5 respectively. Level of supplementation had no significant effect on milk yield at pasture and the total lactation yields were 5222, 5553, 5919, 5848 and 5946 ± 112.4 kg per cow for treatments 1-5 respectively. There were considerable differences between treatments in liveweights at the end of the winter but these differences had disappeared by the end of the grazing season.

The relationship between concentrate input and total lactation yield has been defined and from this, the optimum concentrate levels for differing ratios of the cost of concentrates and the value of milk have been calculated and will be presented. From the data it would also seem that high and low yielding cows respond equally to a change in concentrate input indicating that all cows irrespective of yield can receive the same level of concentrate when *ad libitum* access is given to good quality silage.

LAMENESS IN DAIRY COWS

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A two year study (March 1979 to February 1981) on lameness in 3,100 dairy cows in 20 dairy herds revealed a mean annual animal incidence of 25%. Individual farm incidence varied from 4% to 54%. Right and left limbs were affected equally. The forelimbs were affected in 18% of cases and the hindlimbs in 82%. The upper limb (defined as consisting of the fetlock joint and the structures above this) was involved in 11% of cases. These conditions were primarily traumatic and usually occurred during the over-wintering period.

Disease conditions of the interdigital skin caused 12% of lameness. Diseases of the claw (or hoof) caused 77% of lameness and thus were the single most important category.

Lateral (outer) and medial (inner) claws were almost equally affected in the fore limb; in the hind limb the lateral claw was affected in 94% of claw disease cases and the medial in only 6%. The hind lateral claw is thus the affected structure in 75% of all hind limb lameness and 62% of all lameness.

The claw disease most frequently diagnosed was septic traumatic pododermatitis (60% of cases). This involved breakdown or penetration of the horn capsule with subsequent irritation of the sensitive tissue. The white line area of the hoof which is an anatomically vulnerable site within the hoof was the area most frequently involved. Ulceration of the sole (pododermatitis circumscripta) was diagnosed in 18% of claw conditions. It occurred only in the hind claws and was most common in the 100 day period post-partum. The condition frequently occurred in both hind feet.

Routine foot trimming, as a preventive measure based on the redistribution of weight between lateral and medial claws in the hindlimb, was evaluated in a field trial using 130 treatment and 130 control animals. The technique seems more promising as an early detection and correction routine rather than a long term prevention.

Routine footbathing was evaluated over the grazing period (April to November inclusive) using a 5% formalin solution in a "pass through" bath. One hundred and twenty treatment and 120 control animals on the same environment were used. Treatment did decrease the incidence of interdigital conditions but it had no effect on the incidence or type of claw disease.

Seasonal, environmental and husbandry influences on claw diseases and on horn quality were discussed.

RESPONSES OF LAMBS TO GROWTH PROMOTERS

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Growth promoters are not widely used in sheep in Ireland and there is comparatively little information available on their efficacy in this species.

A series of experiments have been carried out inThe Agricultural Institute on the effects of anabolic steroids on the performance of Blackface Mountain wether lambs and of suckling and early weaned lowland lambs. The steroids evaluated include Ralgro, Finaplix, Synovex, Revalor and combinations of Ralgro and Finaplix and of Synovex and Finaplix.

The responses to the treatments evaluated have been very variable. In the case of Blackface Mountain lambs fed indoor on concentrates the changes in daily liveweight gain and food conversion efficiency ranged from 0-28% and 0-24% respectively. The best improvement in performance was obtained from a combination of Synovex and Finaplix. This combination gave a good response with lowland lambs also.

OESTRUS BEHAVIOUR IN HEIFERS

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The activity of five beef type heifers and one freemartin, housed and fed on concentrates (2½ kgs per day) and hay, was continuously monitored by time lapse video recording. The records obtained were analysed to determine the effect of oestrus on general activity and the frequency of four specific components of oestrous behaviour. The occurrence of oestrus was assessed by daily blood plasma progesterone assay. The normal behaviour of the heifers was not otherwise interrupted throughout the observation period. Oestrus was defined as the period during which normal behaviour was altered and fifteen such periods were recorded.

The duration of oestrous behaviour was 12 ± 4 hours. This was highly variable and influenced by the number of heifers simultaneously in oestrus. During this period the heifer in oestrus had a marked increase in general activity frequently remaining standing for 80% of the time. After oestrus the general activity declined rapidly returning to normal within 48 hours. When more than two heifers were in oestrus general activity took longer to return to normal.

All heifers showed standing behaviour during oestrus. This activity was not shown at any other time and was absent from the record of the freemartin. The smallest number of "stands" was 4. Heifers recorded as standing on few occasions demonstrated all the other components of oestrous behaviour, e.g. attempting to mount others, sniffing or soliciting. The decreased frequency of standing activity therefore appeared to be caused by a lack of interest on the part of the non-oestrous heifers. There was no obvious reason for this variation in behaviour.

There was no consistent pattern or timing to the other components of behaviour that could be linked either to the beginning or end of standing behaviour. There was considerable variation both in frequency and timing of events both between heifers and between oestrus periods in the same heifer. The most active period of oestrous behaviour was between midnight and 6.00 am (37%) and activity was least (17%) between 6.00 am and noon.

These preliminary observations suggest that visual observations of all heats in small groups of heifers is difficult because of the variation in behaviour that occurs. Each heat period observed in this study included some standing to be mounted behaviour but the short duration (2-20 secs) of each "stand" and, the infrequent occurrence, shows that this specific behaviour can be very difficult to observe. Since the general activity of each heifer in heat arises considerably it may be that an objective measure of activity will prove an aid in heat detection.

THE USE OF A NEW PROSTAGLANDIN ANALOGUE (K11941) FOR INDUCTION OF PARTURITION IN THE SOW

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With increasing economic pressures on pig producers, it is essential that the number of pigs weaned per sow per year be increased. Induction of farrowing at a specified time is one means of increasing the work supervision so that more piglets may be saved at or around the time of birth.

In the present trial 79 sows were randomly assigned to one of 5 groups and received either 1 ml, 2 ml or 3 ml of a synthetic prostaglandin K11941, or 0.7 ml of Estrumate, or 2 ml Saline (control) on day 114 of gestation. The average herd gestation length was 116 days. All prostaglandin analogues effectively induced parturition at mean intervals of 22.3, 24.9, 27.7 and 24.0 hrs respectively; control sows farrowed at a mean interval of 51.1 hrs after injection. Induction of farrowing did not have an effect on birth weight, piglet survival to 3 weeks or on the subsequent weaning to service interval.

In a second trial using a new synthetic progestagen (Regumate), oestrus was effectively controlled using 20 mg/head/day. Using 2 ml of K11941 in similar sows, only a slightly shorter interval to oestrus was observed when compared with controls.

OESTRUS SYNCHRONISATION IN WEANED SOWS USING OESTROGEN

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The synchronisation of oestrus in sows after weaning would significantly improve the annual productivity in a majority of commercial pig herds. This study presents the results of a series of experiments on the use of oestradiol benzoate (O.B.) after weaning for such a purpose. Four groups of sows were injected i.m. with a weight related dose of O.B. 1 or 2 days after weaning at either 3 or 5 weeks *pcst-partum*. All treated sows showed standing oestrus 3 days after injection, with high doses of O.B. (60 ug/kg vs 30 ug/kg) resulting in an abnormal oestrus. O.B. treatment at day + 1 (weaning = day 0) significantly reduced ovulation rates whilst treatment at day + 2, resulted in only a slight decrease which was not significant. Shortening lactation length from 5 to 3 weeks reduced ovluation rates significantly after treatment at day + 2.

Thirteen sows were slaughtered at either day 3 or day 30 *pcst-coitum* and the limited data available indicates that fertilization and conception rates are normal after O.B. treatment.

The endocrine responses to O.B. treatment on day + 2 after weaning at 3 or 5 weeks *pcst-partum* show a consistent synchronisation of both the pre-ovulatory LH surge and the post-ovulatory rise in plasma progesterone indicating that O.B. is effective in synchronising oestrus and ovulation in weaned sows with apparently normal embryo development to 30 days *pcst-coitum*.

HEAT SEEKING BEHAVIOUR OF NEWBORN PIGS

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Covered plywood creep boxes 1.2 m x 0.5 m x 0.4 m high heated by incandescent light bulbs were placed at the front of farrowing pens and provided the sole local heat source for newborn pigs. Piglet behaviour to 4 days of age was studied at two room temperatures 24°C and 17°C. Two experiments were carried out (a) with and (b) without room lighting and involving 12 and 16 sows respectively. Hardly any pigs used the creep boxes on the day of birth but usage increased with age. Usage was significantly greater at 17°C than at 24°C ($P<0.01$) and also tended to be higher in the darkened room. The rectal temperatures of piglets was significantly lower at 17°C ($P<0.01$) at 1 hour, 24 hours and 48 hours of age in both experiments but the difference between the two groups decreased with age. A heated creep box does not appear to provide sufficient protection from chilling for neonatal pigs.

THE DIGESTIBLE AND METABOLISABLE ENERGY VALUE OF A WET LEAF PROTEIN CONCENTRATE FOR PIGS

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Juice was extracted from a precision chopped autumn grass crop, predominantly ryegrass, by pulping in a modified hammer mill and squeezing the pulp on an endless belt press. The juice was adjusted to pH 4.0 with formic acid and the precipitated protein recovered by high speed centrifugation. The average time lapse from preparation of juice was 5-6 days. Protein was recovered as a wet cake with a dry matter content of 21-27%. On a dry matter basis it had 48% crude protein, 15% fat, 8% NDF and 6.6% ash. Prior to use in a metabolism trial it was held at $-20°C$.

Six male castrated littermate pigs averaging 25 kg live weight were used in a digestibility trial. A mineral and vitamin supplemented basal ration of barley was used to which cake was added to provide 20% of the total dry matter intake. A similar soya ration was used as a control.

The digestible (DE) and metabolisable energy (ME) values for the basal ration were 14.4 MJ/kg and 14.2 MJ/kg DM. The corresponding values for the protein cake and soyabean meal are 13.5, 12.3, 15.3 and 14.8 MJ/kg dry matter respectively.

EFFECT OF STOCKING RATE AND ANTIBIOTIC ON PIG PERFORMANCE

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The experiment was undertaken in a naturally ventilated piggery having 40 pens in a common air space. Pens measured 4.7 x 2.3 m and were stocked with either 16 or 18 pigs giving a floor allowance of 0.64 and 0.57 m^2 per pig respectively. Pigs were fed from a feed hopper that allowed 1.6 m feeding space. Feeding was to scale in that sufficient feed was given at 9 am daily to allow a 6-hour feeding period. A fortified barley-soyabean meal ration containing 12.6 MJ DE/kg and 0.8% lysine and supplemented with 0 or 20 ppm Avoparcin was fed throughout. Thus the experiment compared 2 stocking levels x 2 antibiotic levels and involved 1360 pigs selected on the basis of sex and initial weight. The experimental period was from 30 to 80 kg liveweight.

Pig performance was basically good with only 5 pigs dying or taken off the experiment. The higher stocking rate resulted in a significant deterioration in feed intake ($P<0.001$), daily carcass gain ($P\leq.001$) and feed utilization ($P<.01$) while there was an increase in kill-out % ($P<.001$). Antibiotic had no effect on feed intake but it improved carcass gain and feed utilization. Veterinary interventions or mortality were not influenced by treatment.

EFFECT OF STRAW TREATMENT WITH SODIUM HYDROXIDE ON CATTLE PERFORMANCE

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The effects of sodium hydroxide treatment of barley straw were evaluated in two experiments. In experiment 1, two groups of 12 bulls (401 kg) were given either treated or untreated straw to appetite plus 5 kg of concentrates (73.5 % barley, 25% soya, 1.5% minerals and vitamins) daily for 187 days. In experiment 2, six groups of eight heifers (309 kg) were individually given treated or untreated straw to appetite plus 4 kg concentrates daily containing 10, 20 or 30% soya for 100 days. A JF SP 2000 machine was used to apply the sodium hydroxide (45 kg/t dry matter (DM)) and the untreated straw was chopped with the same machine. All animals were slaughtered at the end of the experimental periods. In both experiments alkali treatment increased straw digestibility. Estimated carcass gains in experiment 1 were 83.0 and 103.6 kg (s.e. 5.71) for the untreated and treated straws respectively. Corresponding DM intakes were 4.7 and 5.2 (s.e. 0.11) kg/day. In experiment 2, daily straw DM intakes were 3.6, 4.1 and 4.3 (s.e. 0.13) kg respectively for the 10, 20 and 30% soya treatments. However, the level of soya did not affect carcass gain. Average carcass gains for untreated and treated straws were 35.7 and 54.7 (s.e. 1.00) kg respectively. Corresponding straw DM intakes were 3.5 and 4.5 (s.e. 0.10) kg/day. Animals given treated straw had higher willing-out percentages than those given untreated straw, both in experiment 1 (54.0 v. 51.0, s.e. 0.45) and in experiment 2 (49.6 v. 47.4, s.e. 0.26). Treatment of straw with sodium hydroxide increased animal performance but live-weight gain was not a good indicator of carcass gain.