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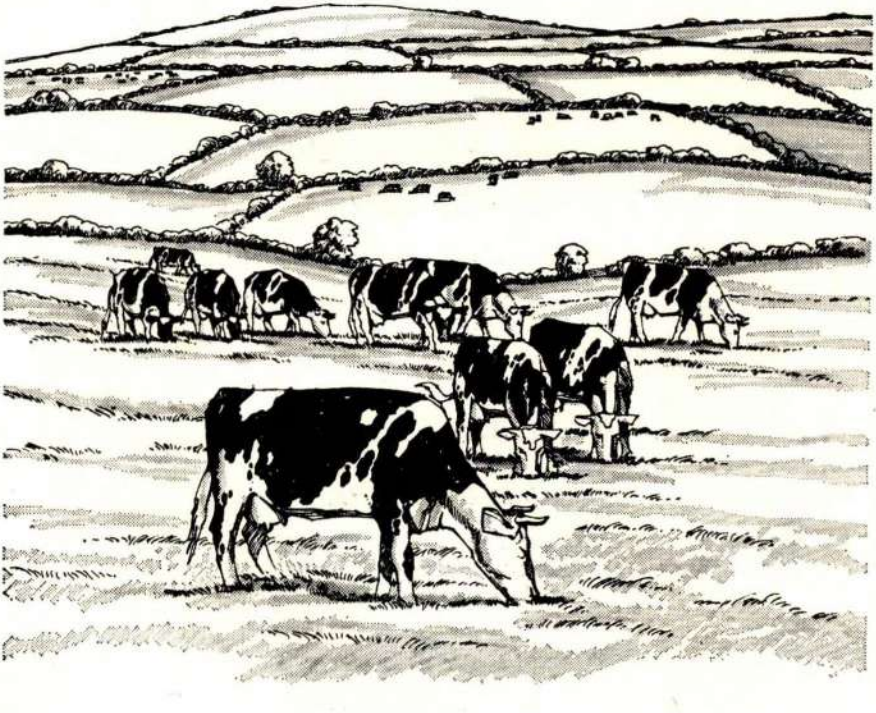

Energy Requirements of Pregnant and Lactating Ewes

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The yield of lambs from a breeding flock is one of the principal factors determining the success of a sheep production system. The feeding of the ewe during the main phases of its production has an inevitable bearing on her lambs. The bodyweight and nutritional status of the ewe at mating will have an important bearing on the number of lambs born to each ewe. The level of nutrition during early pregnancy may effect the level of embryo mortality. The later stages of pregnancy are vitally influenced by maternal nutrition and the ewe becomes progressively more vulnerable to nutritional stress as pregnancy proceeds. Birthweights of the lambs and their subsequent viability are affected by the level of nutrition in the latter part of pregnancy. High birthweights as a result of good feeding gives the lambs an initial weight advantage which, other things being equal, will be maintained till weaning. Conditions favouring adequate ewe nutrition will also favour milk yield and consequently lamb growth rates in early life.

The critical requirements of ewes during late pregnancy and early lactation are described at some length in this paper. But firstly, let us summarise briefly the importance of nutrition prior to mating and in early pregnancy.

Nutrition prior to mating

The practice of improving the nutrition of the ewe prior to mating is commonly called 'flushing'. While the practice has been widely adopted in most of the sheep producing countries, surprisingly little is known of how its influence is exerted. Because of the lack of a clear definition of what constitutes flushing the methods used by different research workers have varied greatly and as a result the available evidence is somewhat conflicting.

Despite the difficulty in interpreting the results of the literature there is no doubt that, under certain conditions, flushing will result in an increased lambing rate due principally to an increased twinning rate. There also appears to be good agreement that the observed differences in fertility are due to the increased incidence of multiple ovulations rather than to a decrease in the number of barren ewes. The effect of ewe body condition at mating on ovulation rate is shown in Table 1.

It is widely accepted that liveweight *per se* of the ewe at mating has an important effect on fertility. Experiments involving different planes of nutrition from weaning to 3 weeks after mating have shown higher

Table I

Effect of ewe body condition at mating on percentage of ewes with 0-2 ovulations*

No. of ovulations	Body condition	
	Good	Poor
0	0	12
1	50	88
2	50	0

*Gunn, R. G., Doney, J. M. and Russel, A. J. F. J. agric. Sci., Camb. **79**, 19-25, 1972.

twinning rates of approximately 6% for each 4.5 kg increase in liveweight of the ewe. However, claims have also been made for a specific flushing effect. In ewes of the same liveweight at mating, those which are gaining weight will have more twins than those maintaining weight which in turn will have more twins than those losing weight. More recently, however, experiments have shown that ovulation rate was not depressed by poor nutrition prior to mating.

In summary there is good evidence to suggest that high levels of fertility are obtained from ewes in which the level of nutrient intake is high, from ewes gaining in weight if originally in moderate body condition and from ewes in good condition at mating even though they may be losing weight.

Nutrition in early pregnancy

Experimental evidence indicates that most embryo deaths occur in the first 3-4 weeks of pregnancy. This is the period in which the developing embryo becomes attached to the wall of the uterus by the developing placenta. Both high and low levels of nutrition immediately after mating have been shown to cause embryonic mortality. The apparent disparity between research findings may possibly be due to the levels of nutrition imposed. Plane of nutrition can mean different things to different people. It would appear, therefore, that in the absence of precise experimental data the level of feeding should not be altered greatly during the first 3-4 weeks after mating.

The growth rate of the foetus proceeds slowly during early pregnancy and by the end of the third month the weight of the uterus and its contents is only about one quarter of the ultimate uterine weight before parturition. Consequently nutrient demands during this period are not critical but severe underfeeding is to be avoided since it can adversely affect lamb development even when nutrition is adequate in late pregnancy. A modest loss in liveweight of about 6-7% in fat ewes during this

*Thompson, W. and Aitken, S. C. (1959. Sheep Bur. Anim. Nutr. Aberdeen. Tech. Commun. No. 20.

period will have no detrimental effect on ewe performance. Furthermore, it is well recognised that, if the feed intake of fat ewes is for any reason suddenly restricted in late pregnancy, these animals are more susceptible to disorders such as pregnancy toxaemia than ewes in a leaner body condition.

Nutrition in late pregnancy

Approximately 75% of foetal growth occurs during the final 6-8 weeks of pregnancy as shown in Table 2. This results in a considerable increase in the ewes' requirements for nutrients and particularly for energy.

Table 2

Mean liveweight increase (kg) of ewes during pregnancy*

	Ewes with singles		Ewes with twins	
	Total L.W.G.	Gain of Gravid Uterus	Total L.W.G.	Gain of Gravid Uterus
Mating to 28 days	0.77	0.09	2.82	0.14
Mating to 56 days	3.10	0.19	5.86	1.64
Mating to 84 days	—	—	9.04	4.18
Mating to 112 days	10.14	4.27	15.32	8.86
Mating to 140 days	16.36	11.36	22.00	20.23

*Wallace, L. R. J. agric .Sci., Camb. **38,** 93-153, 1948.

In the pregnant ewe the foetus obtains its energy from maternal glucose mainly from propionic acid from ingested nutrients. The foetal demand for glucose is high and if the proportion of dietary energy available as glucose is insufficient to meet this demand then in order to maintain glucose levels the ewe begins to draw on her own body reserves. The degree to which she does this depends on (1) nutrient intake, (2) the stage of pregnancy and (3) the weight of foetus(es) she is carrying. Inadequacy of feed during late pregnancy adversely affects lamb birthweights and chances of survival and may lead to losses of ewes. The reaction to undernutrition during late pregnancy may result in two situations. Firstly the growth rate of the foetus(es) may be reduced. This would appear to be the most comon reaction resulting in poor lamb birthweights, reduced vigour and high mortality. The second reaction may be that foetal growth rate continues at the expense of maternal tissue and thus exposing the ewe to pregnancy toxaemia.

Various estimates of requirements of ewes in late pregnancy are available. For example, it is estimated that to prevent loss of maternal weight during late pregnancy a ewe would need to consume 2-3 times as much feed as a non-pregnant animal. In feeding practice, in order to achieve such intakes it would be necessary to supplement the basic roughage diet with liberal quantities of cereals. While cereal prices remain at their present levels this will result in a considerable addition to production costs and will therefore affect the profitability of the enterprise.

Ideally the ewe should gain sufficient weight during late pregnancy to allow optimum development of the reproductive tract and of the udder without loss of weight in other tissues. While this condition may be of great importance in systems such as those based on accelerated rates of reproduction, the aim of a more practical production system might be to allow ewes to mobilize some of their own body reserves to meet any deficit in her intake. Provided the resulting loss in maternal weight is not too severe it will be quickly recovered on spring pasture during the subsequent lactation.

We have recently concluded a series of studies at Creagh to examine the effects of a range of energy levels during late pregnancy on the reproductive performance of the ewe, the aim being to determine the minimum amount of food required by the ewe during late pregnancy consistent with good reproductive performance. In view of the fact that roughages make up the greater proportion of the ewes' diet during pregnancy and because of the increasing use of silage as a feed for sheep, an experiment was also carried out to study the adequacy of silages of varying digestibilities in terms of meeting ewe requirements. In a further experiment we studied the effects of energy supplementation of silage in late pregnancy on ewe performance.

For the purpose of this paper I have selected one experiment to illustrate our findings on the energy requirements of twin bearing ewes in late pregnancy. The energy levels studied together with the birthweights of the lambs and the bodyweight changes of the ewes are given in Table 3.

Table 3

Mean daily nutrient intakes during late pregnancy and lamb birthweights and ewe bodyweight changes

	Treatment		
	Low	Medium	High
Dry matter (g)	608	1004	1256
Metabolisable energy (Mj)	6.5	9.8	11.9
Birthweight (kg)	4.0	4.6	4.4
Ewes :			
Liveweight gain	1.3	10.5	12.8
Net bodyweight change	−10.2	−3.7	−0.8

In these experiments we used a pelleted roughage-concentrate diet. The results show that lamb birthweights were highest on the medium energy level of 9.8 MJ ME (0.42 MJ/kg $W^{0.75}$). Rather curiously there was no significant difference in birthweights between the extreme low and high levels of nergy. While this might suggest that the energy requirements may be closer to the lower level this is clearly not so when lamb mortality (31, 12 and 10% of the Low, Medium and High energy levels respectively) and ewe bodyweight changes are considered.

In farming practice and particularly in the extensive situation it is difficult to judge whether the level of feeding is excessive or inadequate. Ewe bodyweight changes, despite the limitation of not knowing the number of foetuses the ewe is carrying, will serve as a useful guide to nutritional adequacy. In a review of the literature on the effect of plane of nutrition during pregnancy on reproduction, Thompson and Aitken* adopted absolute gain or loss of bodyweight of the ewe as the major criterion of plane of nutrition. They concluded that weight increases less than the weight of the products of conception are still adequate for satisfactory reproductive performance. They suggested that a liveweight gain of 6.4 kg during the final 8 weeks of pregnancy is sufficient for a ewe carrying singles. These weight changes apply to ewes of about 60 kg. The results of our studies (Table 3) show than an ME intake of 9.8 MJ would satisfy these criteria. The net bodyweight loss associated with this level of gain was low (4 kg) while the birthweights of twin lambs were excellent.

A major question in translating the estimated energy requirements into feeding practice is the extent to which the intakes of a roughage, such as silage, satisfy these requirements. A summary of the results showing the in vivo digestibility and intakes of four different silages together with the calculated energy intakes of twin bearing ewes are given in Table 4. The birthweights of single and twin lambs are also included.

Table 4

Mean daily dry matter intakes (g/kg $W^{0.75}$) of silages by ewes and the birthweights of single and twin lambs

	Intake		Birthweights (kg)	
DMD %	Single bearing	Twin bearing	Singles	Twins
58	52.1 (0.45)*	45.6 (0.40)	4.2	3.2
68	36.9 (0.38)	41.2 (0.42)	4.4	3.7
63	39.9 (0.40)	30.9 (0.31)	4.8	3.1
52	42.7 (0.33)	43.8 (0.35)	4.3	3.5

* MJ ME/kg $W^{0.75}$

The results show clearly that silage intakes were variable and were not related to digestibility. The results also show that silage as a sole feed in late pregnancy does not in most instances meet the estimated energy requirements of twin bearing ewes. It is also clear that, in terms of actual

* Thompson, W. and Aitken, S. C. (1959). Sheep Bur. Anim. Nutr. Aberdeen, Tech. Commun. No. 20.

energy intakes, the digestibility of the silage is of major importance. This is very obvious if one compares the intakes and qualities of the first two silages in Table 4. A further consideration in regard to silage feeding is the tendency for silage intakes to decrease with advancing pregnancy when the energy requirements of the ewe are increasing. Thus a computed mean intake over the final 6-8 weeks of pregnancy can be misleading. It is for this reason that supplements are fed with roughages during late pregnancy.

The effects of supplementing silage (D.M.D. % 58) with barley on birthweights and growth rates of twin lambs is shown in Table 5. These results show a significant response in birthweights to supplementing with 13.5 kg rolled barley in late pregnancy. Increasing the barley level to 27 kg did not further improve performance.

Table 5

Birthweights and growth rates of twin lambs to 8 weeks of age (kg)

	Birthweight	Weight at 8 weeks
Silage *ad libitum*	3.2	16.8
Silage *ad libitum* + 13.5 kg rolled barley	4.0	18.4
Silage *ad libitum* + 27 kg rolled barley	3.9	18.0

Nutrition in lactation

Any consideration of nutritional adequacy in late pregnancy cannot be limited to ewe bodyweight changes and lamb birthweights. The subsequent rearing ability of the ewe and growth rate of the lambs in relation to birthweights must be considered. This is of paramount importance in relation to twin lambs when it could well be argued that economies of nutrition in late pregnancy may impair their subsequent growth rates. There is no doubt that the level of nutrition in late pregnancy and the body condition of the ewe at lambing will act as a buffer between nutrient intake and nutrient requirements of ewes during lactation. It is also true that provided nutrition during pregnancy is adequate in terms of lamb birthweights, milk yields and lamb growth rates will depend on the level of nutrition during lactation. In the extensive situation there should be sufficient feed available to the lactating ewe, nevertheless, in the context of twin bearing ewes the first 2 to 3 weeks are of particular importance since it coincides with peaking lactation of the ewe and the critical post-natal period for lamb survival.

The effects of nutrition in this critical post-lambing period were studied by continuing the pregnancy energy levels for 2 weeks in lactation. It must be noted that these levels are much lower than recommended energy levels for lactation. The lowest level (6.5 MJ) is less than that estimated

Table 6

Mean lamb birthweights and performance to 6 weeks of age (kg)

	Birthweight	Liveweight 2 weeks	Liveweight 6 weeks	0-6 weeks
Low	4.0	6.9	14.8	0.26
Medium	4.6	8.3	15.2	0.25
High	4.4	8.6	14.9	0.25

for maintenance of a dry non-pregnant ewe of similar bodyweight to those in the present experiment.

The effects of these levels on lamb growth are shown in Table 6. Lamb growth rates were directly related to energy intake and to milk yields which were 1.03, 1.48 and 1.99 kg per head per day on the Low, Medium and High energy levels respectively. The ewes were then fed *ad libitum* and the results show that lamb growth rates were the reverse of those in early lactation. Milk yields averaged 2.0, 2.2 and 2.6 kg on the Low, Medium and High treatments. These results indicate that despite low levels of energy in late pregnancy and early lactation that ewes will respond to increased nutrition at a point in time before they would have attained normal milk yields.

Table 7

Ewe bodyweight changes (kg) in early lactation

	Low	Medium	High
Post lambing			
0-2 weeks	−8.40	−6.95	−1.48
0-6 weeks	1.35	1.37	2.14

The rate of mobilisation of body reserves in early lactation is shown in Table 7. Ewe weight loss during the period of restricted feeding was directly related to energy intakes. When fed *cd libitum* the ewes on the high energy treatment gained less weight than those on the lower levels. The remarkable recovery of liveweight during early lactation is due to the rapid expansion of appetite of ewes which fed *ad lib* (Fig. 1).

The results in terms of lamb growth rates and ewe bodyweight changes further support the conclusions that an energy intake of 9.8 MJ ME/day or 0.42 MJ/kg $W^{0.75}$ is adequate for the pregnant ewe even in situations of moderate undernourishment in early lactation.

While this experiment does not pinpoint the actual energy requirements of twin bearing ewes during lactation, from other work carried out on

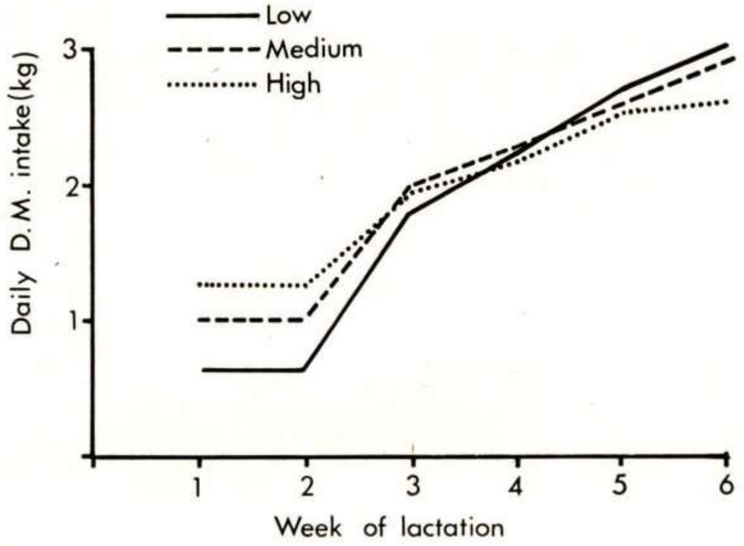

Fig. 1: Voluntary feed intake of ewes in early lactation.

Table 8

ME allowance (MJ/day) required by twin bearing ewes in late pregnancy and early lactation

Ewe liveweight (kg)	Late pregnancy	Early lactation
50	7.89	15.78
60	9.05	18.10
70	10.16	20.32
80	11.23	22.46

lactation requirements it was concluded that the energy levels must be close to twice the estimated pregnancy levels.

A comparison of the energy requirements of twin bearing ewes in late pregnancy and early lactation is given in Table 8.

The approximate estimated theoretical quantities of various feeds needed to meet these requirements for a 60 kg ewe are given in Table 9. The requirements for silage and hay are based on a digestibility value of 65 for both roughages. The ME requirements for dried grass, swedes and barley are calculated from published estimates of their energy concentrations. It must be emphasized that, while these quantities of feeds will satisfy the energy requirements of the ewe in late pregnancy, protein and minerals may be deficient particularly in the case of swedes and barley. It is also evident that silage intakes during late pregnancy would not meet ewe requirements and it is therefore necessary to supplement with concentrates.

Table 9

The quantities required of various feeds required by twin bearing ewes during late pregnancy and early lactation

Feed (kg as fed)	Late pregnancy	Early lactation
Silage	5.85	11.70
Hay	1.23	2.46
Dried grass	1.00	2.00
Swedes	6.36	12.72
Barley	0.82	1.64

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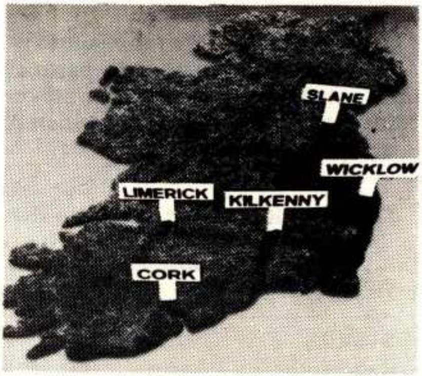

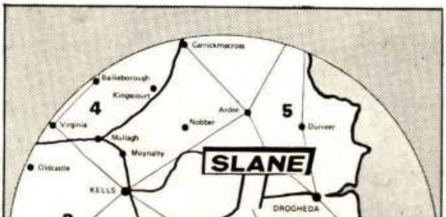

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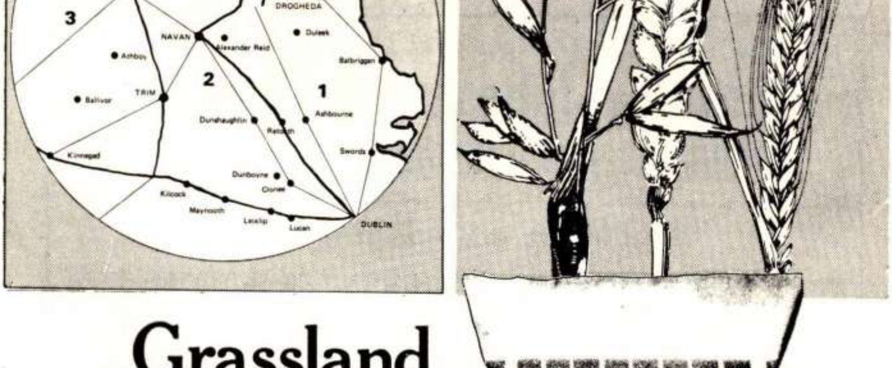

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Grazing Management for Mid-Season Lamb Production

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Mid-season lamb production in Ireland is associated with lambing ewes at a date when pasture growth is expected to meet the nutritional needs of the flock. With the exception of tillage areas, over 95% of the total annual food supply consists of grazed or conserved herbage. Due to the economic necessity to intensify mid-season lamb production from pasture the most important immediate objective is to ensure good pasture production and its efficient use through the application of high stocking rate.

More specifically the aim is to achieve an integrated efficient balance between pasture production and utilisation and sheep husbandry and management practices which will secure sustained acceptable levels of individual sheep performance, output per unit area and economic return. Institute research has developed and tested relatively simple integrated whole package systems which are practically workable and require comparatively low cost and labour inputs.

Research has shown that on developed lowland permanent grassland, using moderate fertiliser inputs (about 77 lb N per acre per annum) and concentrate feed to ewes in late pregnancy (40 lb per ewe) an all year stocking rate of six ewes per acre for mid-season fat lamb production is possible. Adequate fencing and good husbandry are essential for the successful management of these systems. In this paper, firstly the basic requirements for intensive mid-season lamb production from grassland are emphasised, secondly the more important grassland and sheep components are outlined, and thirdly the integration of these components in the whole system are examined.

The basis

Planning and general organisation are the basic requirements for success. This includes the choice of a particular system, an understanding of the target individual sheep and per unit area outputs required, and a suitable husbandry and management programme. Existing weaknesses must be corrected. Handling and wintering facilities should be provided to facilitate efficient production and ease of operation. The inclusion of a programme for disease prevention and control should be an essential feature of the plan.

Grazing management is an important component because it influences the efficiency with which a given quantity of food is apportioned throughout the year in order to meet the nutritional requirements of the flock. An understanding of the following three fundamental factors is essential :

Firstly, the rate of pasture growth varies at different periods of the year and therefore, for a given all year stocking rate in the context of intensification, the supply of food can be expected to be greater than or less than flock requirement according to season. Secondly, the food requirement of the flock varies in association with the different ewe and lamb physiological states throughout the year and do not match the pattern of food supply from pasture. Thirdly, the patterns of food requirement by ewes and lambs in the same flock are not the same throughout the year and this can be exploited to improve grazing management efficiency.

Number of paddocks

A 6-paddock rotational grazing layout is considered adequate for a flock size of up to 200 ewes. Rotational grazing is recommended as it facilitates a better appreciation of how the food supply and demand ratio is progressing. This in turn provides confidence and gives the operator a better opportunity to sub-divide flocks when necessary as well as an improved ability to apportion available herbage.

Date of lambing

The effects on lamb growth rate of turning out ewes to pasture at three different dates in Spring, each at three stocking rates, are shown in Table 1. These results indicate that the stocking rate could be increased by

Table 1

Effects of date of Spring grazing and of stocking rate on lamb growth rate to 12 weeks

Date to pasture	Stocking rate (ewes + lambs/acre)	Lamb growth rate (lb/lamb/day)
March 20	3.25 ± 4.3	0.78
	4.00 ± 5.3	0.71
	4.75 ± 6.3	0.68
April 9	4.00 ± 5.3	0.74
	4.75 ± 6.3	0.76
	5.50 ± 7.3	0.62
April 29	4.75 ± 6.3	0.72
	5.50 ± 7.3	0.71
	6.25 ± 8.3	0.66

about 18% at each of the later dates without reducing lamb daily liveweight gain below about 0.71 lb. There appears to be little justification for commencing lambing earlier than the 10th March or delaying it beyond the 20th March where the stocking rate is at or greater than 5 ewes per acre.

If an earlier lambing date is chosen either the stocking rate must be reduced or extra feed must be brought into the system to maintain individual lamb growth rate. Reducing the stocking rate can only be effective in situations where the sheep enterprise is integrated with some other enterprise to avoid poor utilisation later on in the season.

Thus the correct choice of lambing date is an important factor in attempting to achieve a suitable fit between pasture food supply and flock food requirement in the context of a low cost grassland based system.

Lambing to weaning

During this period the aim is to obtain a mean daily lamb growth rate of about 0.7 lb. This level of performance corresponds to a mean daily growth rate of about 0.6 lb from birth to drafting or mid-August. Table 2 shows the effects of five all year stocking rates on lamb growth rate and

Table 2

Effects of stocking rate on lamb growth rate and outputs of lamb meat and wool per acre

Stocking rate (ewes/acre/annum)	*Lamb growth rate (lb/day)	Lamb meat output (lb/acre)	Wool output (lb/acre)
3	0.61	145	23
4	0.61	181	28
5	0.59	228	36
6	0.57	269	39
8	0.38	—[1]	47

* Mean growth rate to slaughter or mid-August.

—[1] Proportion of lambs finished varied from 3 to 25%.

the outputs of lamb meat and wool per acre. The important point in relation to grazing management from lambing to weaning is that when the stocking rate approaches the level required to achieve high output and efficient use of herbage the total area must be allocated to grazing.

There is little information to indicate the correct speed of rotation, pasture height and severity of defoliation which give best results during this period. The present state of knowledge suggests that height of herbage has no effect on lamb growth rate provided there is ample availability. It also indicates that dry matter intake begins to fall when the post grazing pasture dry matter residues is less than about 1000 lb per acre or when the amount of herbage available is lower than 3 times their daily intake. In at least one study a slower rotation which is associated with a longer rest period and higher herbage gave better results. These results as well as more recent findings at Creagh (which were not direct comparisons) indicate that both ewe intake and milk production are higher when pasture is high. As pasture height and density affect the size of bite and rate of biting, sheep are forced to increase their time spent grazing when pasture availability is lower to maintain their intake.

There is a need for much more information on all of these pasture characteristics and associated sheep responses under Irish conditions before a definitive grazing management programme can be advocated. The main points are that after lambing the aim is to provide an adequate supply of food to meet the greatly increased nutritional requirements of the ewe and to realise that lamb growth rate during the first 10 weeks or so of life is closely related to the milk yield of the ewe.

A 2-year experiment at Creagh compared lamb weaning ages of 8, 12 and 16 weeks at a standard high stocking rate of 7 ewes + 9 lambs per acre. The results showed that during the period April 12th to August 16th the daily growth rate (0.68 lb) of lambs weaned at 12 weeks of age was greater than in those weaned at 8 (0.60 lb) or 16 (0.62 lb) weeks of age. The earlier weaning ages resulted in a greater amount of total herbage being available for winter feed conservation (Table 3).

Table 3

Conservation (fresh cwt/acre)

Age at weaning	June 19	Oct. 5	Total
8	57	107	164
12	23[1]	129	152
16	20[1]	85	105

[1] Amounts of herbage available but not cut.

There is no advantage in retaining ewes and lambs together beyond the stage at which ewe milk yield is so small as to have no effect on lamb growth rate. It appears from this study that after about 12 weeks the ewes are competing with the lambs for available feed. It will now be shown that the benefits of weaning at the correct age cannot be fully realised unless the post weaning management is correct.

Post weaning management and winter feed

During this period the aims are to obtain adequate winter feed for the ewes and to secure continued good growth rate in lambs. Ewes should be stocked at 15 to 18 per acre from weaning to flushing (i.e. 1st July to the 20th Septemper). This means that $\frac{1}{3}$ of the farm is grazed by weaned ewes. Experience has shown that ewes will lose about 7 lb liveweight under these conditions. Whether this is mainly due to a change in gut fill or body condition is not clear. The important considerations are that this tightening up of ewes which are not pregnant or lactating gives an opportunity to obtain adequate winter feed and to finish remaining lambs.

It was stated earlier that at the higher stocking rates the total area must be allocated to grazing from lambing to weaning. After weaning half of the farm should be closed for early September cut silage. About 11 cwt of silage per ewe is required. Under the intensive grassland plan the conservation date must be postponed to about early September and the question of whether hay or silage is better does not arise due to the obvious risks associated with hay at this late date.

Table 4 shows the results of a 2-year experiment which compared post weaning stocking rates of 12, 18 and 24 lambs per acre. The results are intended to give guidelines as to which stocking rate would be chosen depending on the amount of liveweight gain required to achieve the final target liveweight which will be referred to later in the section dealing with

Table 4

Effect of stocking rate on growth rate in weaned lambs

Stocking rate (lambs per acre)	*Total liveweight gain per lamb (lb)	
	1970	1971
12	19.5	13.1
18	16.8	10.0
24	10.5	6.5

* From July 15th to August 31st in 1970 and from July 5th to August 25th in 1971.

drafting of lambs. It is recommended that, in the whole system context, the weaned lambs be allowed access to the silage area up to the time of drafting or mid-August. At 6 ewes per acre and a weaning percentage of 150 the lamb stocking will be approximately 7 lambs or 5½ lambs per acre depending on whether 50% or 60% of them have been drafted by weaning time.

These relatively low lamb stocking rates will ensure that not alone have the lambs a plentiful food supply but also they will have an opportunity to exercise their preferences for preferred plant species or portions of plants or geographic locations all of which tend to contribute to improved intake and liveweight gain.

Drafting of lambs

Part of planning a system is concerned with setting target liveweight and degree of finish at which lambs will be drafted. It is important to adhere to these targets as closely as possible as every draft reduces the stocking rate thereby giving a better opportunity to finish the remaining lambs. Where the objective is to produce a 40 lb carcass, for example, it should be remembered that a liveweight of approximately 85 lb is required up to weaning whereas 95 lb is required later on due to a drop in killing out percentage from approximately 47% to 42%. This aspect is so important that one should not wait for even a slightly greater number to be finished before drafting the few which are ready.

In an intensive mid-season fat lamb system it is recommended that all lambs remaining in mid-August be drafted out whatever their liveweight, otherwise they may seriously affect the amount of winter feed obtained.

The temptation to hold on to some ewe lambs for breeding must also be resisted as this practice belongs to a ewe replacement system.

Flushing

The post weaning management described showed that $\frac{1}{3}$ of the farm is grazed by weaned ewes, $\frac{1}{2}$ of the farm is fertilised for silage and that lambs are grazed on $\frac{2}{3}$ of the farm. This allows $\frac{1}{6}$ of the farm to be rested from mid-August (i.e. after the lambs are drafted) which will give a good start to flushing about 3 weeks before mating date. The regrowth on the silage area will then give an adequate supply of herbage to continue flushing. The $\frac{1}{3}$ of the farm grazed by weaned ewes from early July to late September is then rested to provide a good start to grazing in the following spring.

Winter management

This is the period for which there is the most clear-cup management practice, i.e. remove sheep altogether into wnter quarters and rest the pasture. The general recommendations to achieve a good spring pasture growth is to rest the pasture from not later than the third week of November, apply P and K an apply 45 lb of N about 6 weeks before spring grazing.

Conclusion

I hope that this paper has shown how the more important sheep and grassland management practices should be integrated to satisfy the basic objective of ensuring an adequate supply of nutrients which will sustain the desired outputs per sheep and per acre. Clearly the selection of the correct stocking rate, lambing date and lamb age at weaning is important to achieve the target levels of production. These aspects must be integrated with suitable grazing management, conservation and ewe wintering practices in the context of an efficient whole system.

Further research is required but at the present time it is considered that the adoption of practices outlined here could at least double the output from the grassland area presently devoted to sheep in Ireland.

Sheep Production — Components of Success

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The Meat and Livestock Commission in Britain has been operating a commercial flock recording scheme since 1969. This paper draws on the results from these recorded flocks and concentrates in particular on the variation in performance levels—both physical and financial—achieved, and attempts to explain some of the variation in terms of management practices.

But firstly let us review the profitability of sheep production in Britain over recent years.

Gross margins unadjusted for inflation showed a dramatic increase in the 1970's, nearly doubling between 1970 and 1975, and again between 1975 and 1978. This increase was due almost entirely to lamb price increases keeping well ahead of cost increases. Physical performance per ewe hardly changed, but there was some increase in stocking rates. However, when the gross margins are adjusted for inflation the real value of the increased gross margin was very small, the averages for 1976-78 being about the same as those between 1971 and 1973. The average gross margins in 1979 are likely to be slightly lower than 1978 in real terms, and to be slightly higher again in 1980, but generally not very digerent to the last three-year average.

One reason for the increase in lamb prices not being fully reflected in increased margins is the increase in flock replacement costs which has occurred over the period. As lamb prices have increased so have the cost of replacements, almost in parallel.

Another factor has been the increase in fixed costs. It is always problematical to allocate fixed costs on an enterprise basis but it is important to do so if the real costs of production are to be determined. In a sample of MLC recorded lowland flocks for 1977 and 1979, fixed costs accounted for 60 per cent of total costs; they increased by 24 per cent between 1977 and 1979.

Clearly then there has been no 'bonanza' period for British sheep producers over recent years, the superficial large increases in lamb prices has largely been a reflection of inflation or has been absorbed by higher costs. Nevertheless sheep have probably fared better than any other livestock enterprise over this time period, and margins have undoubtedly been higher in real terms in the 70's than they were in the 60's.

One of the clearest messages to emerge from recording is that good performance always pays best whatever the general cost/price situation. Table 1 shows the relationships between performance and gross margins

Table 1

Relationship between performance and gross margins

	Extra gross margin for extra : 0.1 lambs reared/ewe	0.1 ewes/hectare stocking rate
	£/ewe	£/hectare
1978	+2.17	+2.01
1977	+1.90	+1.79
1976	+2.15	+5.14
1974	+1.26	+2.03
1972	+1.02	+2.15
(Average lowland and upland flocks)		

over a number of years. The benefits of improved performance have always been substantial. The general cost/price situation within which flockmasters have to operate their flocks cannot be changed in the short-term—if it is not satisfactory in the long-term producers will go out of sheep production. The best buffer against the general cost/price situation is good performance. Improvement of physical performance is important in both lowland and hill flocks; the difference lies in the level of performance at which improvement is aimed.

Improving performance

So far reference has only been made to average results, but in practice there is tremendous variation between flocks in both physical and financial performance (Table 2).

Table 2

Recorded lowland flock performance levels (5-year average)

	Range* From	Range* To	All flocks
Number of lambs born per ewe lambed	1.0	1.91	1.41
Number of barren ewes as % ewes to ram	0	20.0	8.4
Number of ewe deaths as % ewes to ram	0	17.2	4.2
Number of lambs dead or died at birth as % of all births	1.0	34.5	8.0
Number of lambs died subsequent to birth as % of lambs survived birth	1.0	14.1	5.5
(* 95% of range)			

Table 3 shows the difference between the average and the top third flocks (based on gross margin per hectare). The latter provide a basis for setting tough but realistic targets for lamb production. The top third flocks sell more lambs at higher than average prices, have lower costs despite this higher output and achieve better ewe performance with above average stocking rates.

Table 3

Difference in performance between top third flocks and average (%) 1978

	Lowland	Upland flocks
Lamb sales	+15.8	+13.5
Output	+19.0	+15.1
Concentrate costs	− 1.3	+ 4.7
Lambs born alive per 100 ewes to ram	+ 9.9	+10.2
Lambs reared per 100 ewes to ram	+12.9	+12.4
Overall stocking rate (ewes per hectare)	+19.8	+20.9

The results of MLC fixed cost surveys of sheep production shows that there is a very close relationship between gross and net margins, so that good physical performance does relate to higher profitability too (Fig. 1).

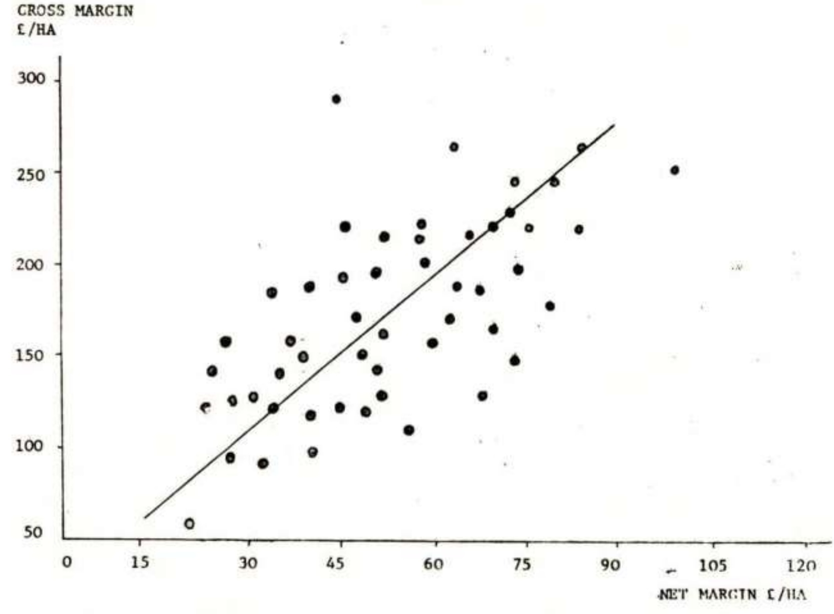


Fig. 1—Relationship between gross margins and net profitability.

The components of success in the breeding flocks are then :

- ★ More lambs reared
- ★ Lower costs
- ★ Higher stocking rates
- ★ Higher lamb values

The contribution of these to higher gross margins is shown in Table 4.

Table 4
Components of top third gross margins

	% contribution to top third superiority in	
	Gross margin per ewe	Gross margin per hectare
Lowland flocks		
Lambs reared	71	33
Lamb value	21	10
Flock replacement cost	3	2
Feed and forage costs	5	2
Stocking rate	—	53
	100	100
Upland flocks		
Lambs reared	71	41
Lamb value	26	15
Flock replacement costs	5	3
Feed and forage costs	−2	−1
Stocking rate	—	42
	100	100

The two major physical factors affecting gross margins are the number of lambs reared and the stocking rate. The effect of different combinations of stocking rate and the number of lambs reared per ewe are shown in Table 5. Four categories of flock were considered :

Above average stocking rate — above average lambs reared
— below average lambs reared
Below average stocking rate — above average lambs reared
— below average lambs reared

The highest gross margin per ewe occurred in the high lambing performance, low stocking rate group of flocks. Not surprisingly, the lowest was for the low lambing performance, low stocking rate group. The highest average gross margin per hectare was the high stocking rate, high lambing performance group. The high lambing performance, low stocking rate group gave the next highest gross margin above the low lambing performance, high stocking rate group. The differences in gross margins per hectare between the four groups were similarly variable for both

Table 5

The effect of the number of lambs reared and stocking rate on gross margins (Ave. of 1977 and 1978)

	No. lambs reared per ewe High	No. lambs reared per ewe Low	
No. lambs reared per ewe	1.49	1.26	
Overall stocking rate (ewes/hectare)	12.1	12.5	STOCKING
Concentrates (kg/ewe)	60	55	RATE
Lamb price (£/lamb)	23.6	24.1	HIGH
Lamb sales (£/ewe)	35.2	30.4	▲
Flock replacement cost (£/ewe)	5.4	4.6	——
Total feed and forage costs (£/ewe)	10.3	9.6	12.3
Gross margin per ewe (£)	20.4	17.9	——
Gross margin per hectare (£)	245.2	222.9	
No. of lambs reared per ewe	1.57	1.31	
Overall stocking rate (ewes/hectare)	9.2	8.7	
Concentrates (kg/ewe)	51	50	LOW
Lamb price (£/lamb)	24.6	24.9	▲
Lamb sales (£/ewe)	38.6	32.6	——
Flock replacement cost (£/ewe)	5.3	4.2	8.9
Total feed and forage costs (£/ewe)	9.0	8.7	——
Gross margin per ewe (£)	25.5	21.0	
Gross margin per hectare (£)	237.3	183.3	

gross margin per ewe and per hectare. Lamb prices were lower in the high stocking rate group.

The components of success are the same whatever the type of flock—up'and, lowland, grass finishing, forage finishing, store lambs or hoggets. Changing the system of production might be the right management decision in individual farm situations to better suit the whole farm plan. But, having changed the system, the need to achieve good performance will still be as strong as ever; the change might however allow this to be more readily achieved. Average results for contrasting production systems are very similar (Table 6).

Table 6

Gross margins for different sheep systems—5-year average 1974-78 (adjusted for inflation)

	Early lambing flocks	Grass lamb flocks	Forage lamb flocks	Hogget production
Gross margin per ewe (£)	17.7	19.6	20.5	21.1
Gross margin per hectare (£)	221.3	205.8	203.0	200.5

Lambs reared

The number of lambs eventually reared is the combination of a number of factors, all of which have a major effect on the rearing percentage. These are the number of empty ewes, number of ewes dying before lambing, number of lambs born, the number of lambs born dead or dying at or around birth, and finally the number of live lambs which subsequently die.

Results from MLC flocks show that although the number of lambs born per ewe lambed is the biggest single source of variation in the number of lambs reared, each of the separate wastage factors has a significant effect. Individual flocks may have a problem with a single factor but it is more often the case that a low level of performance in one factor is associated with an equally poor performance in several others. Whilst differences between breeds and crosses account for some of the variation between flocks in these vital performance factors, differences in the management and feeding of the ewes are more important and it is to these that individual producers must direct their main attention.

Table 7

Commercial ewe performance in average and top third flocks (6-year average)

Some major crosses	Management* level	Per 100 ewes to ram			
		Lambed	Total lambs born	Reared	Live lambs born per ewe lambed
Dorset Horn crosses	Average	92	147	132	1.51
	top third	95	168	140	1.58
Greyface	Average	93	174	153	1.75
	top third	96	198	168	1.86
Masham	Average	92	172	152	1.77
	top third	95	196	167	1.87
Mule	Average	93	176	154	1.76
	top third	96	201	168	1.89
Scotch Halfbred	Average	92	171	150	1.73
	top third	95	195	165	1.88
Suffolk x Masham	Average	93	173	152	1.72
	top third	96	197	162	1.82
Suffolk x Mule	Average	93	169	151	1.71
	top third	96	193	161	1.83
Suffolk x Scotch Halfbred	Average	91	163	143	1.66
	top third	94	186	155	1.78

(* Top third—performance in flocks in the top third on grass margins per hectare).

Table 7 summarises the performance of several types of British cross-bred ewes in commercial flocks and highlights the disparities in ewe performance between the average flocks and those achieving the top third gross margins per hectare. The range in average performance between different ewe types of similar bodyweight is smaller than the variation in performance of individual breed types in flocks of different management levels. There are naturally exceptions to this generalisation. The Finish Landrace produces many more lambs than would be deduced for its size. The impact of the Finish Landrace in crossing in Britain has been very marginal—it contributes an insignificant quantity of genes into the final meat lamb. Thus, for most situations in Britain the generalisation that, taking account of body size, lamb rearing percentage differences between crosses are relatively small, holds good. Producers should concern themselves with choosing a type of ewe to suit individual farm and marketing requirements rather than stock them according to body size. Differences in output per hectare at the same level of management will generally be small.

Inadequate or inappropriate feeding is often a major contributor to losses at each stage, but health/disease aspects are also important. Whatever the reason for losses, it is important to keep some simple records of numbers so that the reasons for a low lamb rearing percentage can be ascertained.

Body condition scoring

A considerable research effort over the last 10 years has provided a much clearer insight into the feed requirements of the ewe at different times of the year. The problem in practice is the application of this information in the flock situation where there are ewes of varying body size, with different requirements and with a spread of lambing dates. The methodical evaluation of the body condition of ewes using a scoring system is a useful indicator of the nutritional status of a flock and allows more precise feeding practices to be applied.

It has been clearly demonstrated by MLC and others that there is a close relationship between body condition and performance—lambing percentages, and spread of lambing (Table 8). The scoring system is based

Table 8

Relationship between flock condition score and flock performance

Breed or cross		Percentage of ewes in flock at different condition scores									Flock average body condition score	No. of lambs per 100 ewes to ram	Spread of lambing (days)
		1	1½	2	2½	3	3½	4	4½	5			
Scotch Halfbred	1*	0	0	0	12.1	25.5	50.4	6.0	6.0	0	3.3	174	44
flocks	2**	0.5	4.0	33.5	30.5	17.5	12.0	2.0	0	0	2.2	128	69
Masham	1*	0	0.5	3.6	6.5	34.7	26.2	20.0	7.6	1.0	3.4	169	39
flocks	2**	0.5	3.5	18.7	29.9	30.4	15.1	1.9	0	0	2.1	126	67

* Flock 1—good condition at mating

** Flock 2—poor condition at mating

on a standardised handling technique and the allocation of a score in the range from 1 (very thin) to 5 (very fat). Target scores have been established for ewes at different stages of production and in different environmental situations. Target scores for lowland flocks at different times in the production year are shown in Table 9. Most flocks (Table 8) contain

Table 9

Target body condition scores for lowland ewes

6 weeks pre-mating	$2\frac{1}{2}$
Mating	$3 - 3\frac{1}{2}$
Mid-pregnancy	$2\frac{1}{2}$
Lambing	$2 - 2\frac{1}{2}$
Weaning	2

a significant group of ewes which do not achieve the appropriate target scores and which benefit from specific management. If ewes are in the right body condition and the results are still low then a more detailed investigation as to the reasons will be necessary. Again, some basic physical records will help with this type of evaluation.

In many flock situations better lamb survival is a more urgent problem than the increase of litter size. The results of a lamb loss investigation in a sample of MLC lowland flocks are shown in Table 10. Clearly most

Table 10

Lamb deaths in lowland flocks

Proportion of lambs dying at different ages (%):

0-7 days	8-30 days	30+ days	Unknown
64	12	3	21

Causes of lamb deaths (%):		
	Mismothering/starvation	41
	Physical damage	3
	E Coli scour/septicaemia	15
	Pneumonia	2
	Abcess/peritonitis/navel ill	4
	Miscellaneous	16
	No cause found	20

lamb losses occur within the first seven days of life and starvation and mismothering are the biggest single cause of loss. This again reflects directly on management, proper lambing facilities, skilled supervision and the strategic tube feeding of colostrum all make major contributions to lamb survival. Improved control of microbic and parasitic disease has greatly reduced wastage but improvements in the timing of prophylactic and therapeutic programmes could reduce losses further. Medicines and veterinary costs comprise on average almost 10 per cent of the variable costs per ewe, but there are flocks in which these costs are considerably higher without any complementary increase in the gross margins per ewe.

Sale value of lambs

The value of the slaughtered lamb and consequently the gross output per ewe is affected by the date of sale, due to seasonal variation in prices. The ratio between feed and forage costs and lamb sales differs between systems of production and is most sensitive in the early lamb production systems (2.7 : 1) with their higher feed and forage costs (average 3.8 : 1 in hogget systems, see Table 13). Quick growth to slaughter weight is an important factor in determining the returns from the production of early out-of-season lambs and lambs off grass. Growth rate is of less importance in late lamb and hogget production off forage crops where the final carcase weight obtained is relatively more important. Growth rate is influenced by breed and also by stocking rate. It is important that a decision on the optimum system of production is made on an individual farm basis. Then, breeds and stocking rates can be adapted to best meet the objectives.

Market requirements for lamb differ markedly, but the two major variables are weight and fatness. Differential prices between top third and average producers have increased markedly over recent years and now account for about 12 per cent of the superiority in gross margin per hectare or the top third (Table 4). Regional and time of sale differences between the average and top third units do not account for all of this large difference which reflects real differences in marketing skills of the top third producers.

Carcase weights for different types of lambs can be predicted within a reasonable degree of accuracy from their parent bodyweight (Table 11).

Table 11

Predicting lamb carcase weight (kg)

Breed weight of ram (Suffolk)	91
Breed weight of ewe (Clun Forest)	73
	164 ÷ 4
Slaughter weight of lamb	41
Carcase weight	20.5

Liveweight can also give a guide to the average fatness of batches of lambs within a breed type. Lambs slaughtered at the average for the parent breeds will typically fall into fat class 3 on the MLC scale. Lambs slaughtered about 10 per cent above or below the average slaughter weight of a particular breed or cross will classify as 4 or 2 for fatness.

These can only be guides; they can be refined further by, for example, slaughtering wether lambs 5 per cent above and ewe lambs 10 per cent below the average liveweight derived from the adult body weights of the parents in order to achieve the same level of fatness.

The only precise way of assessing the market requirement and sending back the information to the producer is some form of carcase classification system. Having established a system it must then be transformed into a method that farmers can use on the farm to predict from the live animal the likely carcase classification of the dead lamb. Such a system depends on the handling and methodical scoring of lambs for subcutaneous fatness.

Practice in handling is essential to assess accurately the fatness level of individual lambs before slaughter and, until experience is acquired, the carcases should be examined after weighing and classification. If a visit to the abattoir is not possible, then carcase classification results will show the level of accuracy attained in the selection of lambs.

Some 14 per cent (1 in 7) of British lamb carcases fall into fat classes 4 & 5. This means that such lambs are overfat in terms of most wholesalers' requirements. At least nine per cent of the weight of fat class 4 carcases and 13 per cent of the weight of fat class 5 carcases are likely to be trimmed before retail sale. Additionally, not all of the excessive fat can be assessed from a fat trim percentage alone; the extent of untrimmable fat in joints is just as important because of its influence on consumer satisfaction. It is apparent from the rapid decline in sheepmeat consumption in Britain over the last decade (from 11 kg per head/year in the early 1960's to 7 kg/head/year currently) that the quality of the product, compared with other meats, is unable to satisfy demand. Producers should not consider that the high lamb prices created by the Continental market reflect general consumer satisfaction in their product. A major challenge facing the British sheep industry as a whole is the reduction of fatness in lambs. Lamb will find it increasingly difficult to compete with other meats if this problem is not overcome.

Where wholesalers are paying different prices for lambs of different fatness, it is important for the flock owner to assess carefully the advantage of increasing weight against the penalty which may be incurred through the carcase being too fat.

Costs

Reference has already been made to the fact that in the MLC surveys, fixed costs account for 60 per cent of total costs. Labour is the highest single item of costs accounting for nearly 40 per cent of fixed costs. A high proportion of the labour figure in this specific survey in both lowland and upland flocks was accounted for by family labour costs. Fixed costs by their very nature are more a reflection of the whole farming situation rather than specific to a single enterprise, but clearly the level of labour costs are uneconomically high in some situations.

Table 12
Production variable costs—% of total

	Lowland		Upland	
	Average	Top third	Average	Top third
Flock replacements	33	30	29	25
Concentrates	28	30	26	29
Forage costs	28	28	31	32
Vet and medicine	8	8	9	9
Others	4	4	5	6
	100	100	100	100

Table 12 shows the proportion of variable costs accounted for by different items in both lowland and upland farms. The contribution to total variable costs is similar in lowland and upland flocks, and for average and top third flocks within each category. Between them replacements, concentrate and forage costs account for about 85 per cent of total variable costs.

Flock replacement costs

On the variable cost side there are opportunities for useful reductions in most sheep flocks and the first to be considered is the flock replacement cost. Flock replacement costs account for about a third of the direct costs of production. The factors which control the cost of maintaining the breeding stock are the number of replacements required annually and their purchase price in relation to the price received for culled breeding stock. The number of replacements required is determined by the normal length of breeding life of ewes and their mortality rate. In practice, replacement and selling policies are flexible, varying with circumstances particularly with market prices. The length of breeding life in the flock can be increased by breeding from ewe lambs and by reducing the rate of premature culling. The true extent of premature culling may be partially masked by economic opportunism in disposing of cast ewes in a favourable market. Careful attention to the health and feeding of the flock could allow a high proportion of the ewes in many flocks to produce an extra lamb crop, providing the over-age ewes do not suffer an abnormally high death rate or cause the value of the cull ewes to drop too markedly. The practice of mating ewe lambs reduces flock costs since the average breeding life is normally increased and it also increases the number of lambs available for sale. A more planned approach to replacement policies could undoubtedly bring about important economies in many flocks.

Feed and forage costs

Feed and forage costs account for over half of the direct costs of production. There is a wide range in feed and forage costs between recorded flocks in similar systems of sheep production. Results from recorded flocks show that there is no direct correlation between the value of feed inputs and the gross output. The more efficient flocks have lower feed costs than average, largely because less concentrates are used. In the top third flocks the feeding of concentrates is more precisely related to the flocks' requirements by ensuring compact lambing groups for feeding —Table 13. As the fertility level of the flock rises it becomes increasingly important to adjust the feeding levels to the requirement of the ewe at key stages of production. This is an area where practical methods of applying technical knowledge on the nutritional requirement of the ewe can be improved and will yield much benefit.

Table 13

Feed inputs and production for different sheep systems

	Lowland—Spring lambing flocks				Early lambing flocks		Upland flocks	
	Grass lambs		Forage lambs					
	Ave.	Top ⅓	Ave.	Top ⅓	Ave.	Top ⅓	Ave.	Top ⅓
Spread of lambing (days)	63	42	64	41	51	36	59	40
Concentrates/ewe (kg)	52	51	60	56	94	96	33	35
Grass requirements/ head (ha)	0.09	0.08	0.10	0.09	0.08	0.07	0.12	0.10
Lambs reared/ewe	1.40	1.60	1.38	1.53	1.35	1.50	1.25	1.45
Return of lamb sales to feed and forage costs	3.8:1	4.5:1	3.2:1	3.9:1	2.7:1	3.1:1	4.7:1	5.3:1

Table 13 shows how sensitive the early lambing systems are to changes in feed and lamb prices. The average ratio of lamb sales to feed and forage costs over the last five years has been only 2.7 : 1, this compares with about 3.5 : 1 in other lowland systems and 4.7 : 1 in upland systems. Even in the top third early lambing flocks the ratio has only averaged 3.1 : 1.

Stocking rate

Despite the very close relationship between stocking rate and gross margin referred to earlier the overall usage of fertiliser nitrogen is low in sheep production in relation to the economic response that can be expected, particularly in the case of permanent pasture. Less than 10 per cent of recorded flocks on permanent pasture receive more than 150 kg N per hectare, for flocks on leys less than 15 per cent fall into this category (Table 14).

Table 14

Distribution of fertiliser nitrogen usage in recorded lowland flocks

Fertiliser N usage (kg/ha)	Per cent of recorded flocks Permanent pasture	Leys
0	20	5
1 - 50	24	13
50 - 100	32	54
100 - 150	15	16
150 - 200	7	7
200 plus	2	5
	—	—
Average N usage per ha (kg)	62	90

The distribution of gross margins per hectare in lowland flocks by stocking rate and fertiliser N levels is shown in Table 15. Between the top third and the average there is about a 30 per cent difference in fertiliser N usage and a 20 per cent difference in stocking rate. Between the average and the bottom third a 30 per cent difference in fertiliser N usage is associated with a 30 per cent difference in stocking rate.

Table 15

Distribution of gross margins per hectare by overall stocking rate—lowland flocks (average of 1977 and 1978)

Stocking rate ewes/ha	Below 6	6-8	8-10	10-12	12-14	14-16	Over 16
Gross margin/ha (£)	154.2	170.2	205.2	247.6	291.2	321.9	338.4

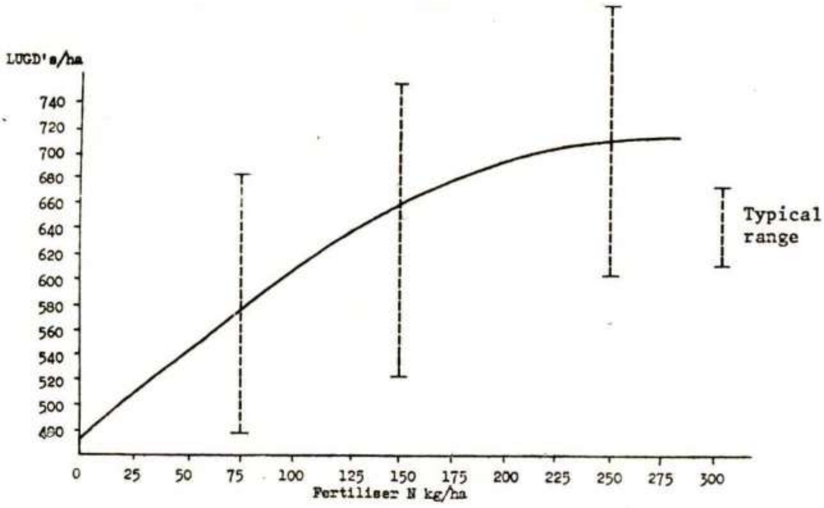
Distribution of gross margins per hectare by fertiliser N usage per grass hectare

Fertiliser N kg/ha	Below 30	30-60	60-90	90-120	120-150	150+
Gross margin per ha (£)	210.5	218.5	234.6	236.5	277.4	313.38

Results from recorded flocks also show that there is a close average relationship between fertiliser N usage and utilised output (expressed as LUGD, livestock unit grazing days*). This is shown in Fig. 2. This relationship is best explained by a curve which flattens off appreciably above 200 kg N/hectare, well below the point at which grass production in relation to fertiliser N usage ceases to be linear. This suggests that sheep producers find it difficult to make the most efficient utilisation of grass growth at high fertiliser N levels. Associated with this average

* 1 LUGD = Amount of grass consumed in 24 hours by a 500 kg cow yielding 3640 litres.

FIGURE 2. RELATIONSHIP BETWEEN FERTILISER N LEVELS & LUGD's/HECTARE



relationship there is considerable variation in stocking rate at each level of fertiliser N usage. Differences between farms due to factors such as weather, location and soil do not account for a substantial proportion of the variation which reflects wide differences in the efficiency of utilisation of the grass produced.

Guide-line stocking rates have been produced by MLC. These are based on estimates of grass production for different quality sites (based on the National Grassland Manuring Trial, GM20), and the nutritional allowances for ewes of different body size and prolificacy. Examples of these guide-line stocking rates are shown in Table 16. They have been expressed on the basis of weight of ewes and lambs because of the wide range of body size and fertility that exists between different breeds and crosses of ewes. In commercial practice there is only a limited relationship between size of ewe and stocking rates; the theoretical advantages of small ewes in relation to lower maintenance requirements are by no means fully taken into account. Total ewe and lamb weights per hectare can be converted into stocking rates for different types of ewe according to the breed weights, fertility and predicted lamb slaughter weights. These guide-lines form a reliable basis for planning. They will require modification in individual farm situations but unless grass production and flock requirements are approximately in balance any further refinement of grassland management is of limited value.

A closer look at the relationship between gross margin per hectare and stocking rate reveals a distinct fall in gross margin per ewe despite the

Table 16

Example guides to stocking rates at different levels of fertiliser N and different quality sites

Kg N/ha		Poor	Average	Good
0-75	Ewe weight/ha (kg)	650	750	850
	Weight of lamb produced/ha (kg)	500	600	700
	Total	1150	1350	1550
75-150	Ewe weight/ha (kg)	750	900	1050
	Weight of lamb produced/ha (kg)	650	750	850
	Total	1400	1650	1900
150-225	Ewe weight/ha (kg)	900	1050	1200
	Weight of lamb produced/ha (kg)	750	850	1000
	Total	1650	1900	2200
225-300	Ewe weight/ha (kg)	N/A	1200	1350
	Weight of lamb produced/ha (kg)		950	1100
	Total		2150	2450

higher gross margin per hectare. This is almost entirely due to a reduction in the number of lambs reared per ewe and reduced value of the lambs reared—lower weights and fewer finished off grass (Table 17). If the level

Table 17

Analysis of recorded flock results by overall stocking rate

Stocking rate (ewes/ha)	6-8	8-10	10-12	12-14	14-16	Over 16
Gross margin per ha (£)	170.2	205.2	247.6	291.2	321.9	338.4
Gross margin per ewe (£)	23.9	22.8	22.2	21.6	20.7	19.7
Lamb sales per ewe (£-	36.3	34.9	33.8	33.1	31.8	30.2
Lamb value (£)	25.2	24.4	23.8	23.6	22.7	21.7
Lambs reared per ewe	1.44	1.43	1.42	1.40	1.40	1.39
Costs per ewe (inc. replacement cost)	15.5	15.8	14.7	14.7	14.2	13.8

of ewe performance (number and value of lambs reared) achieved at moderate stocking rates (6-8 ewes per hectare) were achieved by the intensively stocked flocks (16-17 ewes per hectare) then this would have a major effect on the gross margins per hectare. Alternatively, the highest gross margins per hectare could be achieved with fewer ewes per hectare if lamb performaice was maintained—over the last three years 14 ewes per hectare would have given the same gross margin per hectare as 17 ewes per hectare if lamb performance was equivalent to that in the lower stocking rate flocks. This is of increasing importance as the value of breeding stock and consequent working capital requirements continue to increase. The lower stocking rate situation in the example just given would produce the same gross margin with an 18 per cent lower requirement for working capital per hectare. The gross margin expressed as a percentage of the working capital would have been 45 instead of 37. The main reasons for the lower individual lamb performance levels are herbage shortage during the second half of the grazing season with competition from ewes and lambs and parasitism. Management practices required to overcome this involve the integration of grazing with conservation areas, choice of lambing date, early maturing ram breed, mid-season forage crops, use of a lower sheep stocking rate by bringing-in cattle, preferential grazing for ewes with multiples, choice of weaning date and judicious use of supplementary feed. The appropriate package of management practices needs to be carefully tailored to the individual farm situation.

Parasitic worms are a major problem in many situations, the sensible use of anthelmintics can reduce worm infection but the most effective way of reducing worms in lambs is to graze ewes and lambs on clean land ie, pastures which have been free from lambs or ewe hoggs during the previous 12 months. The problem is how to find clean grazing when and where it is required. MLC records show that many producers spend a considerable amount of money on worm drugs but often they are used inappropriately and are not built into a grazing strategy. To operate a clean grazing system it is essential to plan ahead to ensure that sheep do not graze the same land between breeding and weaning two years running. The grazing history of the pasture is essential information for the planning of a cattle programme. The clean grazing approach in its entirety cannot be applied on farms where cattle are not also kept other than in the case of one-year leys.

Sheep and Cattle on Wexford Farms

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Whilst the emphasis in this paper is on sheep production it is appropriate that cattle should also be included because there are no farms in Co. Wexford with sheep only, and 97% of farms have cattle as an enterprise. Of the farms that have a sheep enterprise, all have tillage crops and practically all have a cattle enterprise. It is against this background that we examine the sheep industry in the county, which has much in common with other lowland sheep production areas in the south east.

Sheep production is an enterprise on approximately 35% of the 5,500 farms in the county. The sheep industry in Co. Wexford competes with alternative enterprises in a thriving agricultural industry. The soil has a wide use range and hence farmers have options in choosing profitable enterprises.

About 30% of the total area of the county is devoted to tillage. In those areas which carry the greatest number of ewes about 45% of the land is tilled. Sheep enterprises have competed favourably for profitability with other enterprises. About 60% of the 3,100 farmers in the Farm Modernisation Scheme are categorised as Development and Commercial.

In Co. Wexford, tillage has been complementary to sheep enterprises such as early lamb production, mid-season lamb production and particularly the finishing of store lambs over the winter which was the most common sheep enterprise until recently. Thus, there is a tradition of sheep farming, combined with tillage and cattle, on dry tillage soils of the county.

Ewe numbers and breeds

The number of breeding ewes in the county did not fluctuate markedly in the 1970's, when lowland ewe numbers in the country as a whole decreased very significantly. The fact that ewe numbers were maintained in the county was due to :

(a) A tradition of sheep farming.
(b) The enterprise dovetailed neatly with the farming pattern.
(c) Sheep production competed financially with other enterprises on the farm.

Of the 107,000 ewes in the county in 1977, about 70% were Suffolk Crosses and the remaining 30% were mainly Cheviot types. The Suffolk is the predominant sire breed and some Dorset Horn rams are used for early fat lamb production. More recently the Texel has been introduced as a sire breed.

Production systems

The Suffolk cross ewe is commonly used for the production system best suited to Wexford farmers, namely, mid-season fat lamb production.

Many flock owners are now concentrating on producing more mid-season fat lambs, with some early lambs mainly on the smaller holdings. This is a change which has occurred in the past two years from the traditional finishing of store lambs on turnips.

A mid-season fat lamb production system fits in very well with the grass growth pattern of the county and with seasonal labour demands. With young leys and the geographical position of the county, grass growth is reasonably early but the maintenance of a good sward of grass in July-August on the dry type of soil in the county can be difficult. A production system of weaning in mid-February to March and selling fat lambs in June-July certainly has much to offer in the county.

Physical factors and returns

The average flock size in Co. Wexford is 65 ewes per farm. The stocking rate for the country is the equivalent of 3 ewes per acre with the better farmers carrying the equivalent of 4 ewes per acre. It is estimated that only $\frac{1}{4}$ to $\frac{1}{3}$ of the area under grassland on the average sheep farm in the county is devoted to sheep. Cattle utilise the greater portion of the grassland on the dry stock farms.

In early 1978, when the bilateral agreement with France came into operation, the county Advisory Service examined the economic prospects for sheep in the county. Farm accounts from 30 selected farms were studied before the new agreement was reached. Selection of farms was on the basis of good performance in tillage, cattle and sheep output. The results on income are summarised in Table 1.

Table 1

Gross margin from farm enterprises on 30 selected farms in Co. Wexford in 1977.

Gross margin	Sheep	Cattle	Malting Barley
per acre	£100	£78	£134

Some efficiency factors in flock performance on these 30 farms are shown in Table 2.

Table 2

Flock performance on 30 selected farms 1977

Average farm size acres	Average flock size	Stocking rate ewes/acre equivalent	% Lambs weaned
150	105	4	1.25

In 1978 gross margins in a range of farm enterprises were compared. The opportunity for such comparisons arose when economic returns from sugar beet growing were being examined on a random sample of farms classified as low, medium or high yields namely, 13 tons, 17 tons or 20 tons/acre. Table 3 summarises the gross margins.

Table 3

Gross margins (£/acre) for enterprises on farms with low, medium or high yields of sugar beet in 1978

	Low	Medium	High	Average
Sugar beet	132	230	309	224
Wheat	116	136	135	129
Malting barley	115	155	139	136
Feed barley	137	127	140	135
Dairying	250	227	269	240
Cattle	80	99	100	90
Sheep	121	119	172	137

Although Wexford has the second highest stocking rate in the twenty-six counties, Wexford sheep farmers have the capacity to increase ewes to 150,000 and at the same time increase the stocking rate of cattle by approximately ¼ of a livestock unit per acre by the adoption of better management practices.

(1) A System of Production

The management skills required to carry out efficiently any one system of production are numerous, be it early, mid-season or store lambs. Having more than one system of sheep production on the farm, in my opinion, may result in the key management factors of production being overlooked. Farmers should adopt a system of production which fits into the farming pattern as well as giving economical returns.

(2) Wintering

Sheep wintering at present is mainly outdoor on grass, sugar beet tops and swedes, but over the past three years there is an increased interest in the housing of ewes on straw and feeding them on hay and meals. This system would seem to be much more acceptable to the Wexford farmer than other wintering systems like slats and silage. The cost of straw bedded housing is approximately £30 per ewe after grant, or £40 gross. This type of housing has a flexibility that the tillage/dry stock farmer likes.

Wintering facilities must be acceptable to the shepherd as well as being tailored to the production system. It should be noted that the family members are frequently the shepherds at weaning time. In the future, when larger flocks may be a necessity, hired supervision will be required at yeaning if mortality is to be reduced.

(3) **Better fencing**

After lamb price, fencing is probably the most important management factor that will affect ewe numbers on farms. This is particularly true on tillage farms. Fencing must facilitate the ever increasing width of combine harvesters and at the same time be stock proof and give an efficient grazing system. One must ask why, in a county such as Wexford, are there so few farmers practising mixed grazing ? I would suggest that :

(a) Farmers believe, contrary to research findings, that cattle and sheep grazing the same pasture have an adverse affect on the daily live-weight gain of both cattle and sheep, particularly on cattle performance.

(b) On the majority of farms only 2 or 3 fields are reasonably fenced for sheep, hence those fields are kept for sheep.

If we are to increase the numbers of sheep and cattle on tillage farms, fencing is a priority.

Factors Affecting Carcass Composition in Beef Cattle

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The objective of a carcass classification scheme is to classify carcasses according to economically important characteristics and thereby facilitate payment to producers on the basis of these characteristics. The value of a carcass depends mainly on its meat yield but carcass weight, shape and muscle thickness are also important. The objective in beef production should be to produce meat which is highly acceptable to the processor and consumer. High percentages of fat or bone in a carcass reduce its meat yield and consequently its value.

Within sexes, payment to date has largely been at a flat rate per kg carcass, but in future the price paid to producers will be more related to the carcass meat yield. Therefore it is important to understand how several different factors affect meat yield so that producers can aim to optimize meat production rather than simply carcass production. This paper attempts to summarize the present state of knowledge on the main factors which affect carcass meat yield.

Carcass development

Before discussing differences between carcasses in meat yield, it is necessary to understand firstly how the carcass develops in terms of its composition (i.e. percentage of bone, muscle and fat). In the young animal the percentages of bone and muscle are high and there is very little fat. With increasing weight, bone percentage declines gradually to maturity. Muscle percentage first increases for a period, the remains relatively constant for a further period and subsequently declines. Fat percentage remains low until the onset of the fattening phase and thereafter increase rapidly. Thereafter, once fattening commences, muscle percentage and consequently meat percentage declines with increasing weight. While this general pattern or development is common to all cattle, the relaive rates of change for the three tissues are influenced by a number of factors, the most important being (1) sex, (2) breed type, (3) slaughter weight, (4) plane of nutrition, (5) type of diet, (6) growth promoters.

Sex effects

Three sex categories are recognized in commercial beef production—bulls, steers and heifers. Compared with steers, bulls grow faster, use feed more efficiently and have a higher percentage of meat in the carcass. Table 1 shows the average carcass composition of bulls and steers from seven experiments at Grange (Harte, 1969a). Because bulls grew faster,

Table 1

Carcass composition of bulls and steers—average of 7 experiments (Harte, 1968)

	Bulls	Steers
Carcass weight (kg)	239	211
% Meat	71.2	67.1
% Bone	18.6	18.8
% Fat	9.3	13.3

they had heacvier carcasses and in addition they had lower fat and higher meat percentages. As a result, every 14 kg of bull carcass yielded the same quantity of meat as 15 kg of steer carcass. When account is taken also of their greater carcass weight, five bulls yielded as much as six steers.

The difference in meat yield between bulls and steers is not the same at all slaughter weights because their main tissues grow at different rates. Relative to overall carcass growth, the rate of muscle growth is higher and the rate of fat growth is lower in bulls than in steers. Consequently, the difference in meat percentage between the two increases with increasing weight. This was illustrated in an experiment in which both bulls and steers were slaughtered at two ages and consequently at two different weights (Harte, 1969b). The results are shown in Table 2. At the lower carcass weights, the bulls had only 2.8 percentage units more meat than the steers whereas at the higher weights the difference was 7.7 percentage units in favour of the bulls.

Table 2

Carcass composition of bulls and steers at two slaughter weights

	Low slaughter weight		High slaughter weight	
	Bulls	Steers	Bulls	Steers
Carcass wt. (kg)	220	201	320	278
% Meat	69.0	66.2	71.8	64.1
% Bone	20.4	20.5	15.7	16.3
% Fat	9.3	12.0	10.7	18.6

Although bull beef production has been extensively studied in this country, it has not been adopted in commercial practice. This contrasts with the situation in many other European countries where bull beef production is common.

There is less information on tissue growth patterns of heifers. The main difference between heifers and steers is that heifers commence fattening at lower weights. Once fattening has commenced relative rates of fat and muscle growth are about the same in heifers and steers (Berg *et al*, 1979).

Although there are clear differences in carcass composition between breed types, the size of the difference depends on the basis of comparison. Comparisons are usually made at either the same age, the same slaughter weight or the same level of fatness (finish). The data in Table 3 are taken from a United States study (Germ Plasm Evaluation Programme, 1974)

Table 3

Carcass composition of different breed crosses slaughtered at the same age

Sire breed	Charolais	Simmental	Limousin	Hereford	Angus
Carcass wt. (kg)	324	315	301	294	296
% Meat	69.3	68.4	69.8	65.8	65.5
% Bone	12.9	13.3	12.6	12.2	11.9
% Fat	17.8	18.2	17.5	22.2	22.8

in which the steer progeny of bulls from different breeds mated to Hereford and Angus cows were slaughtered at the same age. In addition to having heavier carcasses, the continental crosses had on average 3.5 percentage units more meat and 4.7 percentage units less fat than the Hereford and Angus types.

An experiment in France (Geay, 1976) compared pure bred Charolais, Limousin and Friesian bulls slaughtered at the same carcass weight (312 kg). The data, which are in Table 4, show that the Charolais had 6.3 percentage units more meat and 6.2 percentage units less fat than the Friesians. The main difference between the Charolais and Limousin breeds was that the latter had more fat and less bone. These results emphasise the superiority of the continental breeds over Friesians in carcass quality and indicate the type of carcasses with which Irish beef must compete in European markets.

Table 4

Carcass composition of pure bred bulls slaughtered at the same weight[(a)]

	Charolais	Limousin	Friesian
% Meat	70.3	71.2	64.0
% Bone	18.0	14.5	18.6
% Fat	9.7	12.8	15.9

(a) 312 kg carcases

In Britain, the Meat and Livestock Commission have compared the carcasses of different breed types slaughtered at the same level of fatness (MLC, 1978). The data in Table 5 refer to the steer progeny of dairy cows and a number of different sire breeds.

Table 5

Meat percentages of different breed crosses at the same level of subcutaneous fat (finish)[a]

Breed type	Charolais	Simmental	Friesian	Hereford	Angus
Carcass wt. (kg)	290	265	241	221	201
% Meat	71.2	70.9	70.0	70.5	71.4

[a] Average for 18 and 24 month old production systems.

When fat level was standardised the differences between the various breed types in meat percentage were small but there were large differences in the carcass weights at which these similar meat percentages occurred. The carcasses of Charolais crosses were almost 50 kg heavier than those of the Friesians which in turn were 40 kg heavier than the Angus crosses. These data show that continental type cattle can be taken to much heavier weights than Friesians and still have high quality carcasses whereas the traditional British beef breeds must be slaughtered at lighter weights in order to achieve high carcass meat percentages. It should be noted that the carcass weights in this MLC study were much lower than commercial carcass weights in Ireland generally.

Slaughter weight effects

Since the weight at which cattle are slaughtered is completely under the control of the producer, it is important that the influence of slaughter weight on carcass composition and meat percentage be fully understood. Results show that when animals reach a certain weight, the percentage of fat in the carcass increases and the percentage of meat decreases with increasing weight. The rate at which this happens varies with sex, breed, level and type of feed. For a similar increase in carcass weight there is a greater increase in fat percentage and a greater decrease in meat percentage in steers than in bulls. Similarly the late maturing continental breed types fatten less rapidly than the early maturing traditional breed types.

The effects of increasing slaughter weight on the carcass composition of Friesian steers are shown in Table 6. Fat percentage increased with increasing carcass weight while meat and bone percentages decreased. Over the carcass weight range of 260 to 340 kg, meat yield declined by 0.65 percentage units for every 10 kg increase in carcass weight.

Table 6

Carcass composition of Friesian steers at different slaughter weights

	Carcass weight (kg)			
	150	260	300	340
% Meat	73.4	69.6	65.5	64.4
% Bone	21.6	19.5	19.0	17.9
% Fat	5.0	10.9	15.5	17.7

Plane of nutrition effects

As in the case of slaughter weight, plane of nutrition is also controlled by the producer. Thus, it is equally important to know how it affects carcass composition. Opinions differ among research workers on the extent to which nutrition influences composition. Some studies have shown only small effects of nutrition on composition whereas in other cases quite large effects were recorded. In an experiment carried out in the United States (Keane *et al*, 1979) the effect of nutrition on the composition of Charolais and Simmental cross steers fed from 208kg to

Table 7
Average composition[a] of Charolais and Simmental cross steers fed two levels of nutrition

Level of nutrition	High	Medium
Daily gain (kg)	1.47	1.34
Carcass wt. (kg)	330.8	331.3
% Meat	60.9	62.1
% Bone	16.4	16.3
% Fat	22.7	21.6

[a] of round + rump

slaughter at 550kg liveweight was negligible (Table 7). Other studies in the United States (Prior *et al*, 1977) also found that level of feeding had little effect on the composition of continental breed types but in the small breed types, high planes of nutrition resulted in increased fat and reduced meat percentages.

The effects of plane of nutrition on the carcass composition of Friesian steers was investigated in an experiment at Grange. The cattle were fed high, moderate or low levels of nutrition and slaughtered at 230, 285 and 340 kg carcass weights to separate the effects of nutrition and slaughter weight. Table 8 shows the percentage carcass subcutaneous fat in the various treatment groups. Fatness increased with increasing slaughter weight on all planes of nutrition. In addition increases in the level of nutrition increased fatness at all slaughter weights. Of course, the cattle

Table 8
Percentage subcutaneous fat in Friesian steers fed different levels of nutrition

Level of nutrition	Carcass weight (kg)		
	230	285	340
High	8.5	12.1	14.2
Moderate	7.7	9.7	13.0
Low	5.9	7.3	10.7

fed on the higher levels of nutrition grew faster and reached their slaughter weights earlier. Therefore, although they had more fat they had less bone and as a result there were only small differences in meat percentage between the different nutritional levels. In Ireland, where grazed and conserved grass are the main feeds for beef cattle and where high levels of concentrate feeding are generally uneconomic, the possibilities for influencing carcass meat percentage by manipulating nutrition levels are limited.

Diet type effects

The dry matter content of conserved grass affects the carcass composition of cattle. Work at Grange some years ago (McCarrick, 1966) showed that cattle fed silage were fatter than those fed hay. More recently it has been shown that animals fed unwilted silage were fatter than those fed wilted silage (Flynn, 1978). Cattle being finished for slaughter on silage are generally fed concentrate supplements. An experiment was carried out in which a commonly used diet of unwilted silage supplemented with rolled barley was compared with a prepared diet based on concentrates (mainly rolled barley) and chopped straw. Both diets had adequate protein, minerals and vitamins and had the same estimated energy value (11 MJ ME/kg DM). Friesian steers were used in the experiment. They had similar rates of gain on the two diets and were slaughtered at 260, 300 and 340 kg carcass weights. The effects of the diets on fat and meat percentages are shown in Table 9.

Table 9

Fat and meat percentages of cattle fed silage/barley or concentrate/straw diets

		Carcass weight (kg)		
		260	300	340
% Fat :	Silage/barley	11.2	16.6	20.4
	Concentrate/straw	11.0	15.3	16.6
% Meat :	Silage/barley	69.7	64.9	62.1
	Concentrate/straw	70.0	66.0	65.7

In agreement with results shown earlier, fat percentage increased and meat percentage declined with increasing slaughter weight. There was an effect of type of diet on carcass composition but it was not the same at all slaughter weights. At 260 kg carcass weights, there was little difference between the diets in carcass composition. However, as carcass weight increased the effects of diet became more pronounced and at 340 kg the differences were 3.8 percentage units more fat and 3.6 percentage units units less meat for the silage and barley fed cattle.

While the results of this experiment show that the silage based diet increased fatness, at present this factor alone is not sufficient to justify any change by producers in the use of unwilted silage for beef cattle.

Growth promoter effects

Information on the effects of growth promoters on carcass composition is limited. In an experiment at Grange (Drennan *et al,* 1979) Friesian steers fed silage plus 3 kg barley daily were used to compare the effects on carcass composition of different growth promoting compounds and combinations of compounds. Compared with controls, the feed additive Romensin increased carcass weight and as a result fat percentage was also slightly increased. Ralgro plus Finaplix treatment increased carcass weight also but in addition it reduced fatness and increased meat percentage.

Conclusions

Bulls grow faster but fatten slower than steers while heifers fatten at lighter weights. Equally, continental breed types grow faster and fatten slower than the traditional breeds. Therefore, the superiority in composition of bulls over steers and continentals over traditional breeds increases with increasing weight.

Carcass fat percentage increases and meat percentage decreases with increasing slaughter weight. There are no precise estimates of the rate at which this happens for the different breed types. Approximate estimates obtained from research work indicate that over the normal slaughter weight range there is a decline in meat percentage of 0.54 percentage units for Charolais crosses, 0.65 percentage units for Friesians and 0.80 percentage units for Hereford crosses per 10 kg increase in carcass weight.

Both level of nutrition and type of diet affect carcass composition but in the context of Irish beef production the effects of these factors are small.

In addition to improving growth rate, hormonal type growth promoters also increase meat percentage.

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Beef Carcase Classification and Market Requirements

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Regulations providing for the Beef Carcase Classification Scheme came into effect on August 13th 1979 (1). The scheme is currently being phased in on steers at eleven plants and should be fully operational in 1980. One of the basic objectives of the scheme is to facilitate the transmission of market requirements back through the production and distribution chain to the producer. This paper presents data on current market requirements as determined during classification studies on overseas markets over the past two years. These requirements are discussed in the light of classification returns from export abattoirs during the past six months.

The Classification Scheme is basically a system for describing carcases in a standardised manner (2). Two of the economically most important characteristics described are 'Conformation' and 'Fatness'. The distribution of 57,000 steer carcases among the conformation/fatness subclasses during Autumn 1979 is shown in Table 1.

Table 1

Percent of steer carcases in each Classification Subclass

Fatness Class	Conformation class							
	I	R	E	L	A	N	D	Overall
1	—	—	—	0.1	0.1	—	—	0.2
2	—	0.2	1.2	3.3	0.9	—	—	5.6
3	—	0.6	9.2	14.2	1.4	—	—	25.4
4	—	0.6	16.8	13.9	0.7	—	—	32.0
5	—	0.5	15.2	6.5	0.2	—	—	22.4
6	—	0.4	9.8	2.1	—	—	—	12.3
7	—	0.1	1.6	0.4	—	—	—	2.1
Overall	—	2.4	53.8	40.5	3.3	—	—	100.0

Average carcase wt. = 315.2 kg; N = 57,217.

The conformation scale is constructed in such a way that Classes E (good commercial type) and L (average dairy type) are numerically the most important. Class A can be regarded as 'reject' level for steers but, as the scale also covers cows, would be regarded as a good commercial cow carcase. Class R for steers is a superior type, while Class I (extra) is very exclusive, with less than 0.1% of carcases, and is designed to cater for the exceptionally well conformed carcases common in some European countries. The fat scale is constructed to give an approximately normal distribution about the central class, 4.

Of the factors determining economic value of carcases, yield of saleable meat is perhaps the most important. The relationship between subclass and yield of saleable meat is shown in Table 2. A standardised commercial cutting method (3) was used to separate 431 steer carcases into 'saleable meat', 'fat trim' and 'bone'. Fatness class is the most important determinent of yield, ranging from an average yield of 71.2% for fatness class 2 to 63.4% for fatness class 7. Conformation is also important in determining yield but only at low fat levels, e.g. fatness class 2, conformation class I yields 77.3%, R yields 74.2% and E yields 71.1%. But at higher fat levels (class 4) the conformation effect is insignificant; I yielding 69.0%, R yielding 68.9% and E yielding 68.1%.

Table 2

Effect of conformation and fatness class on yield of saleable meat (Steer carcase; N=431)

Fatness Class	Conformation class							
	I	R	E	L	A	N	D	Overall
1	—	—	—	—	—	—	—	—
2	77.3	74.2	71.1	70.8	69.6	70.0	—	71.2
3	74.5	70.3	70.0	69.7	69.0	68.7	—	70.1
4	69.0	68.9	68.1	67.9	65.7			68.3
5	71.1	68.3	67.1	68.2	—			67.7
6	67.8	67.6	66.1	65.6	—			66.9
7	63.6	63.4	62.7	65.6	—			63.4
Overall	69.5	68.6	69.2	69.2	69.8			68.9

It is clear, therefore, that carcases vary considerably in value according to variations in conformation and fatness. These differences in value are reflected in prices obtainable on open wholesale markets. In a study carried out at Rungis market in Paris in 1978 (4) classification data were related to wholesale price. The study showed that conformation and carcase weight are the most important detriments of price in this market. Fatness is relatively unimportant, largely because all carcases sold in Rungis are pre-selected and trimmed down to an acceptable relatively uniform level of fatness. Mean prices for each conformation weight sub-class are presented in Table 3. An additional category, 'X', was created to cater for the double muscled carcases found in Rungis.

The magnitude of the premium for heavy, well conformed carcases is somewhat surprising and is certainly greater than justified by the higher

Table 3

Effect of weight and conformation class on wholesale price (Rungis 1978)
(price in pence per Kg; N=210)

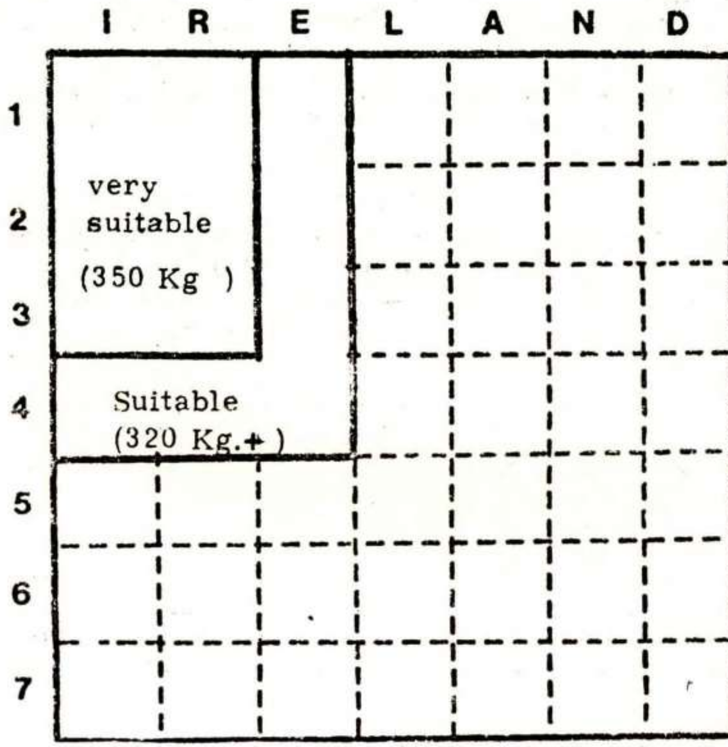
Weight Range	Conformation class				
	X	I	R	E	L
500 Kg +	257	207	186	166	—
460-500 Kg	257	—	182	161	—
420-460 Kg	239	189	166	160	157
380-420	—	186	172	155	144
Under 380 Kg	—	—	—	153	144
Overall	243	193	174	160	154

yields of saleable meat (5). Whatever the reason, the implications for Irish cattle production are significant, e.g. a typical Irish steer carcase of 320kg and conformation class E would realise a price of 153p/kg. An improvement of one class in conformation (to R) and an increase of 60kg in carcase weight would realise a price increase of 19p/kg—a premium of £164 per carcase. However, of the sample of 57,000 carcases classified during Autumn 1979, only 150 carcases could meet these requirements, i.e. less than three container loads from all plants in the country over a three month period.

From this study and from trials carried out in co-operation with exporters and continental buyers it is possible to construct a continental carcase specification—particularly for the prime Paris and Belgian markets (Table 4). The inner grouping of subclasses (IR 123) can be regarded as 'very suitable' and the outer range (IRE 4 and E 123) as suitable but at a discount.

Table 4

Continental steer carcase specification



From the results shown in Table 1 the percentage of our steer carcases meeting these requirements are :

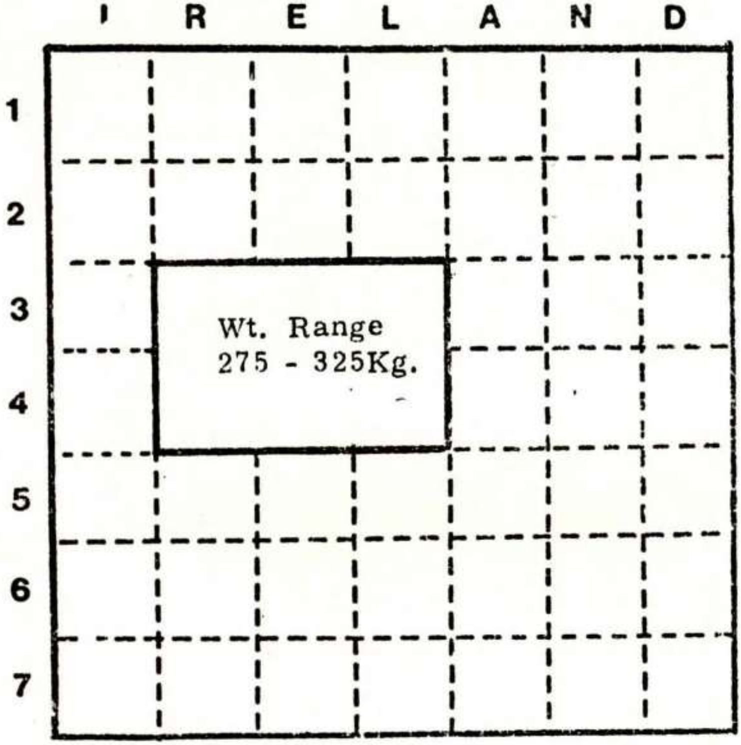
Very suitable :	less than 1%
Suitable :	11%

Currently about 20% of our steer carcases are shipped to the Continent but are only accepted at a discount and following extensive trimming of excess fat.

Turning to our principal export market, the United Kingdom, the situation is more satisfactory. The premium market in the U.K. is the supermarket and retail butchers sector. Preliminary data from a study into the marketing of Irish beef in the U.K. facilitate the construction of a typical U.K. Supermarket purchasing specification (Table 5).

Table 5

U.K. supermarket steer carcase specification



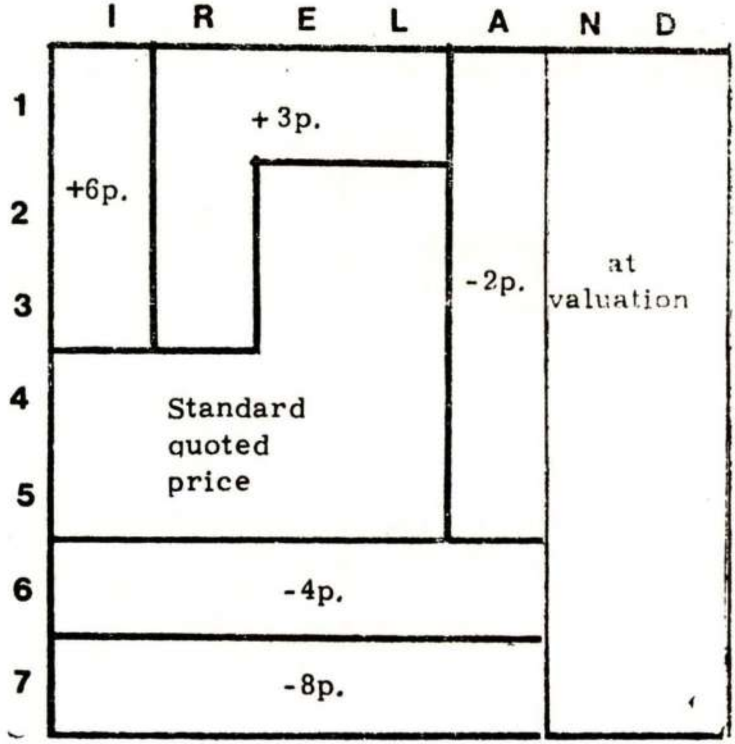
Approximately 25% of our steer slaughterings can meet these requirements. This seems an adequate number to ensure a significant trade with supermarkets, but when spread over all plants it means that only the largest plant can assemble more than two containers per week.

Differences in market value have not in the past been communicated to the producer and so there has been very little incentive to change production methods or breeds to produce a more suitable type of carcase. The Classification scheme facilitates realistic price schedules with payments based on quality differences. It is gratifying to report that several plants are already paying on the basis of classification. Table 6 shows the price schedule currently (December 1979) operated by one plant.

While the premia and penalties do not reflect the full extent of the variation in market value, nevertheless this schedule represents a welcome first step in the right direction. It is to be hoped that all plants will institute realistic price schedules when the classification scheme is fully

Table 6

Actual price schedule (December 1979)
(prices in p/kg carcase)



operational so that the Irish producer will have the opportunity and incentive to improve his product and render it more suitable for current market requirements.

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Use of Grass Varieties in Increasing Production of Beef

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There are presently 47 ryegrass varieties on the Department of Agriculture's recommended list (1). In the Department's assessment, all varieties are tested for at least three years at five centres. Mechanical harvesters are used to determine DM yields and persistency is assessed on a scale of 1-9. Varieties are assessed in maturity groups. It is clearly desirable but impractical to have animal performance data on all of these varieties. Cost factors and land limitations preclude evaluation of such large numbers via the animal. A limited number of varieties are being tested using animal performance as the measuring parameter in the Agricultural Institute.

Connolly *et al* (2) evaluated a small number of ryegrass varieties both as grazed herbage and winter feed silage. Evaluations of these varieties using grazing animals was carried out using extra carrying capacity over and above the standard grass (S_{24}) as the measure of superiority. The model used was the common intercept model (3).

At Johnstown Castle in the years 1977-79 inclusive an evaluation of six varieties ,sown in monoculture, has been conducted. No legume was sown, nitrogen fertiliser input was 250 kg per ha per annum given in 5-6 incremental dressings. A description of the varieties is given in Table 1.

Table 1

Varieties evaluated at Johnstown Castle 1977-79

Variety	Heading date	Ploidy
S_{24}	Early	Diploid
Barpastra	Late	Tetraploid
Sabrina	Early	Tetraploid
Vigor (Melle)	Late	Diploid
Cropper	Early	Diploid
Oakpark	Early	Diploid

The mean effect of variety on liveweight gain is shown in Table 2.

Table 2

Effect of variety on liveweight gain (kg/ha)—mean 1977-79

Variety	LWG	Relative
S_{24}	846	100
Barpastra	819	97
Sabrina	700	83
Vigor	911	108
Cropper	840	99
Oakpark	808	96

Only Sabrina and Vigor results were significantly different from S_{24}.

Seasonality effects were shown by the different varieties. Table 3 illustrates the effect of variety and stocking rate on liveweight gain and percentage of total liveweight gain attained between April and July, 1977-79.

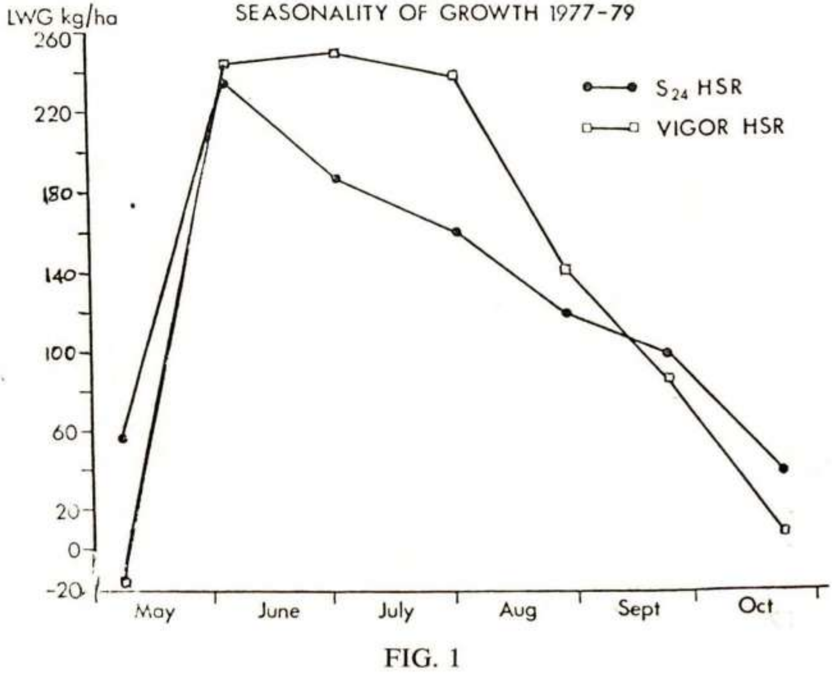


FIG. 1

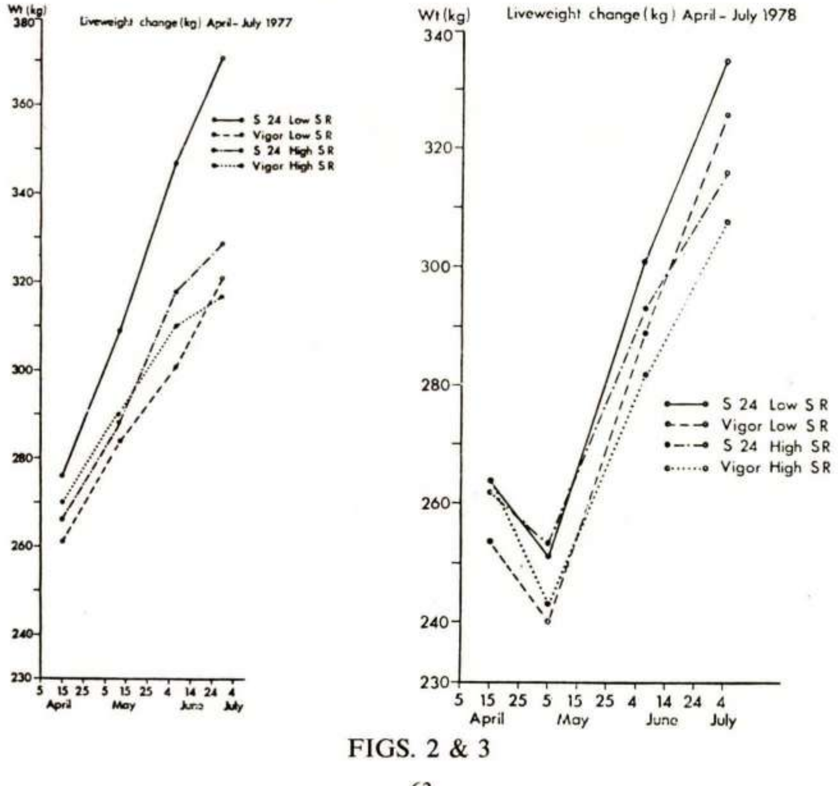
Table 3

Effect of variety and stocking rate on liveweight gain (kg/ha) April to July—mean 1977-79

Variety — SR	LWG	% of annual total by July
S_{24} low SR	577	62
S_{24} high SR	490	55
Barpastra low SR	502	55
Barpastra high SR	414	47
Vigor low SR	452	47
Vigor high SR	477	50
Cropper	552	59
Oakpark	465	53

The period mid-April to early July represents 40 percent of the total grazing season. The early varieties achieved 53 to 62 percent and the late varieties 47 to 55 percent of total annual production in that period.

The relatively good mid-summer production of Vigor compared to S_{24} at the high stocking rate is shown in Fig. 1. The sharp decline in liveweight gain in S_{42} from early June onwards is notable.



FIGS. 2 & 3

There were contrasting weather conditions in the three years of the experiment. The spring of 1977 was normal but the 1978 and 1979 spring seasons were poor for grass growth with resulting effects on liveweight gain of the animals. These effects are shown in Figures 2 and 3 for S_{24} and Vigor.

In 1977 animals on these treatments gained weight without interruption from date of turn-out. However, in 1978 negative liveweight changes occurred in all treatments over the first three weeks after turn-out. The cattle on the late-heading Vigor showed the greatest loss in performance. A month elapsed before the live weights returned to the levels at turn-out. These were fasted weights and while they may not represent actual loss of carcase weight, nevertheless they indicate restriction in DM intake. Maximum possible gains are not likely in these circumstances. The 1979 data are illustrated in Figure 4 and they indicate that the cattle on high stocking rate (HSR) treatments lost weight or gained very little liveweight for two cycles, i.e. five weeks after going to grass. The cattle on low stocking rate treatments (LSR) performed better with only the late variety Vigor showing restriction for one cycle.

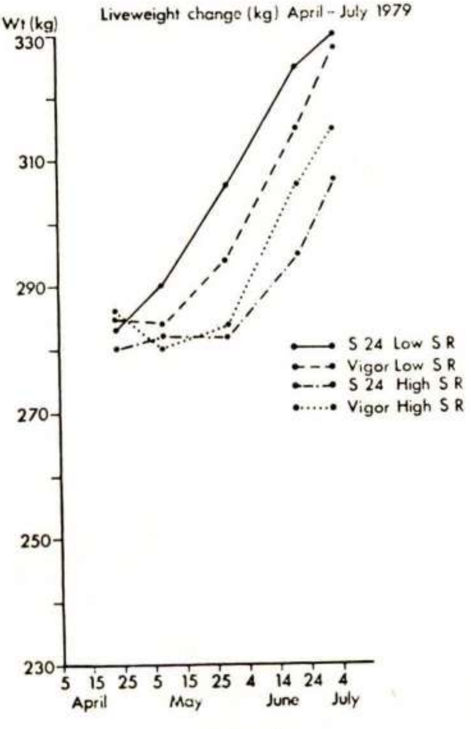


FIG 4

Botanical changes were monitored over time to check on persistence of sown species. These are given in Table 4.

Table 4

Effect of management on percentage ryegrass in swards (%) 1978

Variety	Grazed	Silage + Grazed
S_{24}	80	75
Barpastra	68	44
Sabrina	18	24
Vigor	91	87
Cropper	85	82
Oakpark	82	75

The poor persistence of the teraploids Sabrina and Barpastra is notable. Cutting silage and then grazing the plots adversely affected survival, notably in Barpastra. Vigor showed better persistence than other varieties under both management systems.

A small winter feeding trial comparing the six cultivars was also undertaken. The results are summarised in Table 5.

Table 5

Effect of variety on average daily gain (kg) of steers fed on silage + 2.3 kg beet pulp nuts

Variety	Average daily gain kg/day	Relative
S_{24}	.89	100
Barpastra	.78	88
Sabrina	.93	104
Vigor	.82	93
Cropper	.91	102
Oakpark	.80	90

The results indicate that Sabrina gave much better results as a silage-fed grass than as a grazing grass. However differences shown in Table 5 were not significant. Further studies on the silage feeding value of these varieties are in progress.

It is concluded that there are a number of new ryegrass varieties available which have advantages to offer in terms of good mid-summer production, persistence, silage yield and quality. It behoves the farmer, adviser and research worker alike to seek out these better varieties and to recommend and use only those which have shown their superiority over the standard varieties, especially in trials where measurements of animal production were made.

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A System of Low Cost Production in the United Kingdom

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The location of Trawsgoed Experimental Husbandry Farm on the edge of the coastal belt of mid-Wales plays an important part in determining the type of farming system which can be followed. The climate is relatively mild due to the influence of the Gulf Stream and the rainfall is 1200 mm and is well distributed throughout the year.

The lower part of the farm, which is used predominantly for dairying, is 30 to 100 metres above sea level. The lower land is reasonably level and can be used for grazing and silage while the slopes are steep enough to limit their use to grazing. Perennial ryegrass and white clover sown as semi-permanent swards are the basis of all the grass seeds mixtures and the favourable climate and high rates of fertilizer used result in good yields. In recent years under various systems of grazing management, yields of dry matter per hectare have exceeded 12 tonnes.

One of the objectives in setting up this system of production some twelve years ago was to maximise the amount of milk produced from grass and to minimise the input of purchased concentrates. In order to do this a spring calving herd was established and early work investigated stocking rates and time of calving. Although higher stocking rates have been used, experience has resulted in the 180 Friesian cows being stocked at 2.5 cows per ha of grass receiving approximately 400 kg of nitrogen fertilizer per ha annually. Average annual milk production for 1977-79 was 4586 litres sold per cow and was supported by 618 kg of concentrates per cow. To achieve this level of performance careful investigation of three main aspects of management has been necessary. The date of calving in relation to the date of turnout to grass has a large effect on the amount of milk produced and was investigated in an early series of experiments, the results from which indicated that January/February calving was beneficial from he aspecas of yield, financial return and ease of management. Secondly, to sustain a high level of production from grass some system of grazing management must be practiced and therefore since the spring calving herd was first established three main systems of grassland management have been employed.

The first system used in the early days of the unit was one of paddock grazing, generally with two days spent in individual paddocks and a rotation of 24 days. This was managed in conjunction with an equal area of grassland used mainly for conservation. The management during the grazing season was for early grazing of the conservation area, followed by grazing the paddock area for most of the season, but allowing for supplementation of the paddock area by grazing part of the conservation area if shortages of grass occurred during mid-summer. In the autumn the conservation area was again grazed after the third silage cut had been taken. During the years when this system of grazing management was used, a stocking rate of 3 cows per hectare was maintained.

The second system of grazing management employed was one of set stocking, or more accurately continuous grazing, as a grassland area stocked at 2.5 cows per hectare was used for grazing and the density of stocking controlled by taking conservation from part of the area. For most of the grazing season one half to three quarters of the area was used for grazing and the remainder for conservation. During the early part and at the end of the grazing season the whole area was used for grazing. By this system, although part of the grassland area was continuously grazed, the area was adjusted to ensure that there was always sufficient grass and also that the grazing area was never seriously undergrazed.

The third grazing system consisted of utilizing five or six paddocks in no strict rotation, but always ensuring that the cows had plenty of grass for grazing with any surplus taken as silage. During the course of the grazing season all paddocks were cut for silage at some stage. The stocking rate on this system of management was also 2.5 cows per hectare.

Although these three systems of management were not run as a strict comparison, all were on the farm during some seasons and apparently supported very similar levels of production.

Because of a swing away from paddock grazing to the apparently simpler system of set stocking, a critical comparison of continuous grazing and paddock grazing was started in 1977. The provisional results from three years of this experiment have indicated that rotational grazing, although giving less total DM production, has resulted in higher milk production. This appears to be due to the better rationing of the grazing available, particularly at times of grass shortage. The results for 1977 and 1978 are given in Table 1.

Table 1

Comparison of rotational and continuous grazing

		Rotational	Continuous
Total grass	1977	11.6	12.4
DM production			
tonnes/ha	1978	11.6	12.1
Total lactation	1977	4491	4076
yield kg	1978	5054	4718

In 1979 an investigation into the level of production from grass under a system where *ad libitum* good quality grass was always available to cows, has indicated that higher milk yields may be possible throughout the grazing season. This feature has yet to be combined with a management system to provide adequate returns per hectare.

In a system of milk production where individual cow yields are relatively modest it is imperative that levels of concentrate feeding must not be high if good financial returns are expected. If only a limited amount of concentrate is fed it is obvious that careful consideration must be given to the stage of lactation when it is most profitable to feed concentrates. Three main periods of feeding have been investigated, feeding at grass, steaming up before calving, and feeding in early lactation between calving and turning out in early April.

For a period of seven years, half the cows on an intensive paddock grazing system were fed a flat rate of 1.8 kg of concentrates per day. The overall response to this feeding was 1 kg of milk for every 1.6 kg of concentrates fed. In one year only, did the extra milk pay for the concentrates fed. Access to a feed dispenser while grazing in two years of another trial produced no extra milk in one year and an increase of 1 kg of milk for every 1.7 kg of concentrate fed in the second year.

Silage is fed during the winter period and gives an adequate rate of liveweight gain in the dry period. An experiment was run in the three years 1975-1977 in which two groups of cows were fed good quality silage and one group received in addition 3 kg of concentrates per cow per day for 50 days before calving. The concentrate feeding did not produce any extra milk in the subsequent lactation. A series of experiments has been carried out to measure the response to concentrates fed in early lactation. One experiment for three years compared two levels of flat rate feeding. Cows calving in January/February and in February/April were fed either 5 kgs or 10 kgs of concentrates per day together with *ad libitum* silage. The results are shown in Table 2.

Table 2

Response to concentrates fed in early lactation

Calving period	Silage + 5 kg concentrates	Silage + 10 kg concentrates
January - February		
Lactation yield	4835 kg	5004 kg
Concentrates fed	660 kg	1003 kg
February - April		
Lactation yield	4318 kg	4395 kg
Concentrates fed	471 kg	561 kg

With January/February calving cows the response to doubling the quantity of concentrates fed per day was to produce an extra kilogram of milk for every 2.02 kg of concentrates fed. With February/April calvers a much smaller increase in average yield was also uneconomic.

As a result of this and other experiments it is now the practice with the herd to restrict concentrate feeding to the period from 2-3 weeks before calving until mid-May. During the dry period silage gives an adequate rate of gain and concentrate feeding in early lactation is restricted to 7.5 kg per day for January/February calvers and to 5-6 kg for March calvers. Extra feed is only given if grass production is seriously reduced when some extra concentrates may be used to supplement either grazing or silage.

Nitrogen fertilizers have generally been applied at high rates, approximately 400 kg per has is used per annum. Following six years of high nitrogen fertilizer application to a paddock grazing system, half the area was top-dressed with only 250 kg of nitrogen per hectare each year while the heavier 450 kg dressings were maintained on the other half. The results are shown in Table 3.

Table 3

Nitrogen level on paddocks — milk production litres per ha

	250 kg N	450 kg N
1974	2905 l	2968 l
1975	2659 l	2746 l
1976	2891 l	3082 l

At the end of the three year period milk production from the paddocks receiving the lower level of nitrogen had been reduced by 7% and the amount of time spent grazing the paddocks was considerably reduced with correspondingly more time spent grazing the area allocated for conservation.

One of the problems of spring calving is the production of heifers for herd replacements. Because of the necessity for batch calving at a time to make maximum use of the subsequent grass production, calving can only be at two or three years old. Two year old calving while relatively easy with autumn calvers is more difficult with spring calvers which do not reach an adequate pre calving liveweight with the same ease. As a consequence of this an investigation was started to compare three year old calving with calving a year earlier. It is intended to carry out this investigation through the productive life of the heifers but preliminary results are indicating that the heifers calving at three years are over 75 kg heavier at first calving and over 70 kg heavier at the second calving than those first calving at two year old. The three year old calvers produced 868 kg more milk in the first lactation and only 309 kg more milk in the second lactation. This increase in yield does not compensate for the extra lactation obtained from the two year old calving heifers.

The overall herd performance in 1979, despite the late cold spring, follows closely on results in previous years. The results are shown in

Table 4. The price used in calculating the output was 10.62 p per litre for milk and the price of the home mixed concentrates £104 per tonne.

Table 4

Herd performance 1979

Average number cows	171
Milk sold per cow	4538 l
Milk sales per cow	£482
Concentrates fed per cow	635 kg
Concentrates fed per litre milk	0.14 kg
Margin over concentrates per cow	£416

Calving date has an important effect on yield with much reduced yields for March/April calvers as compared with the January/February calvers. Later calving is associated with much lower levels of concentrate feeding but this is insufficient to compensate for the lower yield and margins are reduced. The contribution of grass to annual milk production is shown in Table 5.

Table 5

Contribution of grass to annual milk production

Calving period	Annual concentrate use kg	Milk yield kg/cow	% total energy from grass
January/February	711	4779	80
February/March	456	4419	86
March/April	203	4083	93

Late calving is associated with the more efficient use of grass but calving in January/February which is now the general pattern in this herd combines good grassland utilization with higher milk yields and better financial returns.

Economics of Low and High Cost Dairying Systems

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Last year the results of a comparison of dairying in our respective countries were summarised (reference 1). It may be argued that the figures, referring to the calendar year 1977, have been overtaken by events, but they serve to emphasise some of the differences between low and high cost systems (Table 1).

Table 1

Physical and financial performance (£ per acre)

	Ireland	England and Wales
Herd size	48	74
Milk yield (galls)	724	1100
Concentrate use (cwts)	8.4	35.4
Stocking rate (acres/cow)	1.4	1.3
Farm gross margin	159	143
Overhead costs	54	99
Profit	105	44

By tradition Irish dairying can be regarded as being low cost in terms of all the major inputs, feed, fertiliser, paid labour, equipment and borrowed money. So far as Britain is concerned the opposite is true. The figures show that while by conventional measures of efficiency, such as herd size and milk yield the Irish levels are below the British levels, they are higher in terms of the factor that really matters, profitability.

At this point it is important to consider why the British and Irish systems of dairying differ to such an extent. Historically Britain has had a far higher milk price than that prevailing in Ireland and profitability has consequently been greater. At the same time there has also been a good deal of prestige associated with a high milk yield per cow. These two factors in combination have encouraged expenditure on commodities assumed to help bring about the desired high yield, namely concentrates and sophisticated technical equipment. Such expenditure has inevitably been encouraged by commercial organisations selling the various products.

Such developments are fine so long as the milk price is high enough to support them. A sophisticated industry is however far more vulnerable to a reduction in price such as that currently taking place.

For the British farmer, operating his high cost system, the outlook is bleak, especially since there is currently little improvement in technical performance; milk yields in our FMS sample being static around 1150 gallons and concentrate use around 36 cwt. Thus the anticipated increase of 11 per cent in milk price for the year ending March 1980 will be inadequate to meet cost increases in general and the rise in overhead costs in particular (Table 2).

Table 2
FMS 82 all-grass farm sample—financial results (£ per acre)

	Year ending March		Percentage change
	1979	1980	
Whole farm gross margin	187	208	+ 12
Overhead costs	136	162	+ 20
Profit	51	46	− 11

Reference 2

Reference to profit is meaningless unless we consider how it is used. The main demands on profit are for loan repayment, tax, capital and private expenditure. In 1979 these amounted to almost £20,000 and resulted in an increase in overdraft of nearly £4,000. The implication of such figures is that at current performance the existing milk price cannot support the present levels of skilled labour, modern technology or borrowed capital.

The lesson for the Irish dairy farmer is that even if current levels of profitability leave him with spare cash, he should be careful not to use it to build an overhead cost structure such as that commonly seen in Britain unless he can achieve physical efficiency well in excess of 1150 gallons from 36 cwt concentrates when stocked at 1.3 acres per cow. This argument is strengthened when we consider that with the current surplus in Europe, the milk price is unlikely to be maintained in real terms. Further there is a possibility, hopefully remote, that the current disagreement amongst EEC members may lead to a breakdown of the Common Agricultural Policy. One of the consequences of such a breakdown may well be to force Irish milk back on to the depressed world market.

It would therefore seem vital that the Irish dairy industry moves forward in a manner that, while not necessarily showing maximum profit under current conditions, maintains a reasonable level of profit in more adverse circumstances. That surely means making the most of Ireland's natural advantage, grass, and being wary of an over capitalised industry.

It should perhaps be remembered that sophisticated capitalisation is not in itself a guarantee of improved physical performance. Indeed the recent ADAS surveys of 'Complete Diet Feeding', surely the ultimate in sophistication, have shown no economic advantages over conventional systems. Indeed examination of some of the conclusions of the most recent report suggest the opposite.

Summary of economic conclusions (Reference 3)

1. There was no clear evidence of complete diet herds improving yields faster than other herds; indeed the evidence indicated the reverse.
2. Complete diet herds used considerably more concentrates per litre of milk produced.
3. Complete diet fed herds did not on average achieve a higher margin over concentrates than conventionally fed herds.
4. There still appears to be no direct financial reward from herds on complete diet feeding.

Such conclusions do not however show that complete diet feeding never has a place in dairy herd management. What they suggest is that the system should be adopted only for reasons such as 'ease of management' rather than for expectation of improved performance. I would argue that such 'ease of management' reasons are far more likely to apply in the east of England where a farmer has access to countless arable by-products than they are in the west of Ireland.

The merits of the latest 'system' of cow feeding—Flat Rate Feeding of Concentrates — must be judged in a similar way. While the results achieved by such as Fred Gordon at Hillsborough and Cled Thomas at Hurley are impressive, it is likely that if the system were adopted by a large number of commercial farmers, results would show no advantage over existing systems. Thus flat rate feeding must be judged on a wider basis, and it is by such a measure that it seems to hold attractions for the Irish farmer.

The philosophy of the system meets the ideals outlined earlier namely, using the natural resource of grassland and being a champion of the simpler approach. In its simplest form flat rate feeding would require a clamp, albeit large, of self-feed silage, a trough for feeding concentrates and an unsophisticated milking parlour. So far as the cows are concerned housing would be of little benefit, but from the farmer's viewpoint probably essential.

Discussion of flat rate feeding tends to mix up two separate issues, firstly the method of feeding concentrates and forage to cows and secondly, the absolute levels of each component. Complete diet and flat rate feeding should be evaluated on whether they seem to be the correct method of feeding for the individual. The wider question of absolute amounts of forage and concentrates is one which all dairy farmers, irrespective of system of feeding, should be asking.

Considering concentrates first, where the FMS average use is currently 35 cwt per cow, there is no indication that the use of anything over about 25 cwt per cow leads to an improvement in gross margin per acre (Table 3).

Table 3

Analysis of performance of 1005 FMS farms by concentrate use (Reference 2)

Concentrate use per cow (cwt)	17	23	27	32	37	46
Gross margin per acre	173	195	217	216	222	221

When examining these figures in the Irish context, it should be remembered that the majority of the herds included in the sample above are autumn calving and that for spring calvers the optimum use is likely to be lower.

When a similar analysis is made on the basis of nitrogen use, some improvement can be seen at the highest levels, although that rate of improvement slows down at about 200 units per acre, around the current FMS average (Table 4).

Table 4

Analysis of performance of 1005 farms by nitrogen use (Reference 2)

Nitrogen use (units per acre)	62	100	139	178	218	259	333
Gross margin per acre	157	193	212	239	238	252	262

The implication of such figures is that the average farmer is likely to get a better financial response from additional fertiliser than from additional concentrates. Such analyses are however sometimes misleading in their application in that the inter-relationships of such as nitrogen use and stocking rate are ignored.

This problem can be overcome by multiple-regression analysis. A recent study (Reference 4) indicated that the direct response to 1 lb nitrogen was about 0.5 gallons of milk while the response to 1 lb concentrates was only about 0.1 gallons milk.

In terms of performance levels shown in the Irish comparison earlier in this paper, it could be argued that there is scope for increase of all inputs. The weight of evidence does however suggest that effort should be concentrated on grassland improvement. This development should take place alongside an attempt to maintain the traditional low-cost approach through which Irish dairying can ensure its future. Lest I be accused of talking abstractly, I would conclude by suggesting that target performance might well be 1100 gallons from 16 cwt concentrates when stocked at 1.2 acres per cow with 250 units of nitrogen, under conditions prevailing in much of western England. In the best areas of Ireland, concentrate use could well be decreased and stocking rate increased to make full use of the potential of the land.

Such performance while not over taxing the system, be that the cow or the grassland, is likely to show a good return in terms of both gross margin and, more importantly, profitability.

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Brucellosis — Strategy for the Farmer

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Although the strategy of controlling Brucellosis on the farm might be simply stated as the "hygienic management of every parturition" it is always helpful to know why one is advised to do one thing and not do another. If one has an adequate knowledge of the disease suitable management methods can be easily deduced to suit one's own farm.

For all practical purposes the route of infection on the farm is via the mouth (it is possible to transmit the disease in other ways but these are not of any great importance in the field). Thus we have to protect animals against eating, drinking, or licking any food, water or other materials that may have become contaminated. For instance, a cow can become infected by licking her legs after paddling through infected mud or slurry. A simpler approach is to prevent these materials from becoming contaminated.

When ingested the organism passes through the mucosa into the lymphatic system where it meets the major defence system of the body. The bacterial cells are engulfed by phagocytes and carried to the next lymphatic gland. Some destruction of the organisms takes place (more or less depending on whether the animal is immunised—vaccinated—or not). In the unvaccinated animal some organisms will survive the passage through the lymphatic system and pass into the blood stream via the thoracic duct — and then become widely dispersed through the body tissues. What happens next depends on the age of the animal, its sex and whether or not it is pregnant.

(i) The young calf and non pregnant heifer are very resistant to infection. After exposure to infection they may show transient blood titres (very few will develop permanent blood titres) which in a matter of six months or so will usually return to negative levels. These animals will have thus acquired a very useful Natural Immunity which will protect them against re-infection in later life. A small percentage of such exposed animals (1-2%) may however, become Latent Carriers —and show no sign of the disease until their first pregnancy ends in an abortion.

It is not a good idea to rely on Natural Immunity as this small number of latent carriers can keep the disease going in cycles for many years in any large herd.

It is better to rear the replacement heifers away from the adult herd, and when they are about a year old to vaccinate them. At this stage, if the adult herd has been cleared of the disease, it might be prudent to carry out an Anamnestic Test on the heifer replacements and remove any possible latent carriers.

Immunisation — whether natural or by vaccination is not 100% effective . It will protect 70-80% of females against reasonable challenge during pregnancy. Hence, we must arrange our management so that in even an accident situation heavy exposure of pregnant females is not possible.

(ii) **The pregnant female**

If **unvaccinated,** the pregnant female has no initial defence against invasion and some organisms will gain access to the uterus and the developing udder. These are the two important predilection sites in cattle.

In the uterus, the developing foetal membranes are particularly attractive to brucella abortus and enormous growth in numbers takes place in them. The foetal cotyledons are damaged and abortion usually follows anytime later than 37 days after infection—a usual interval is about 6 to 8 weeks. At the time of abortion enormous numbers of brucella are released in the placenta, the foetal fluids and in the foetus. All the aborted materials are highly dangerous to both animal and human health.

If no precautions are taken to control the spread of infection in a non-vaccinated herd the likely outcome is that 90-100% of females will abort with a loss of 80% of the calf crop.

In unvaccinated animals an infective dose of 15 million organisms will cause 100% abortions. But a dose as low as 1500 organisms can cause 70% of heifers to abort. Under normal farm conditions 15 million organisms would be a very small dose—emphasising the need for very careful hygiene.

(iii) The vaccinated pregnant female, although still susceptible to heavy challenge, has a very useful degree of immunity—sufficient to cope with environmental risks on a well managed farm.

Subjected to a challenge of 15 million organisms, 70-80% of vaccinated heifers will be completely protected. Of the 20-30% of heifers which will become reactors possibly half of them would have viable calves. This is in marked contrast to the case of the unvaccinated heifers.

(iv) The male calf is quite resistant to infection. At the age of puberty he becomes more susceptible and can become infected in the reproductive tract. Infected bulls sometimes produce infected semen and although they usually appear to cause little harm in natural service their semen can be very infectious if used in AI. Chronic infection can cause sterility.

Animal health

1) An infected cow discharges enormous numbers of organisms at the time of parturition (whether full term or premature). These must not drain into areas where other cattle can come in contact with them.
2) After the placenta is passed the genital tract rapidly involutes and even in a few days the amount of infection being passed may be

minimal or nil. Any cow should thus be kept separate from her comrades at least until after she has cleansed.

3) The loose box should be cleaned out and disinfected after each parturition—and the hind parts of the cow should be sponged down with a suitably diluted disinfectant after cleansing.
4) The calf should be left with the cow for 24 hours so that it will be licked clean and will also get sufficient colostrum. A "wet" calf put in a pen with other calves can spread the disease as its coat can carry heavy infection. Even if the mucous is allowed to dry into the calf's coat it is still infective.
5) Dead calves and foetal membranes must be buried. They must **not** be thrown on a dung heap or slurry tank. They are often lifted with a fork, and moved in a wheelbarrow—both of which should then be cleaned and disinfected.
6) Leave a trough of disinfectant outside each isolation box—and disinfect your boots when going in and coming out.
7) Infection can survive in manure or slurry for 3 months. Thus the manure from the isolation boxes should be stacked in a safe-draining area and allowed to ferment. Ideally, isolation boxes should not drain into the main slurry tank. If they do, slurry must only be spread on non-grazing land.
8) An infected udder is not of any great importance to animal health—even to a calf suckling it (but infected milk is a great hazard to humans.
9) Good herding every day is essential during the season of calvings or possible abortions.

At any sign of impending parturition, or of abdominal discomfort or uneasiness, a pregnant animal should be isolated — at least until it is apparent that she is not going to abort.

Human health

Humans are often quite susceptible to Brucellosis.

1) Ninety per cent of infected cows are infected in the udder and thus produce infected milk—at least intermittently. The milk of such cows will give a positive MRT result. Such milk should never be drunk unless effectively pasteurised.
2) Assisting at an abortion, or even a full term infected parturition can be particularly dangerous as the level of infection on the calf and in the fluids and placenta can be enormous. If so assisting or handling any of these materials, rubber or plastic gloves should be worn. After use they (and any ropes used) should be effectively cleaned, disinfected (or sterilised by boiling)—or buried with the calf and placenta.
3) Placentae should not be manually removed unless the cow is clinically ill with metritis—a decision for your veterinary surgeon.
4) Before removing bedding from an isolation box it should be sprayed with disinfectant—e.g. Halomid.
5) Any clothing contaminated with uterine discharges should be steeped in disinfectant and then washed. Furthermore, any parts of the body

similarly contaminated should be thoroughly washed as soon as possible.

The newborn calf should not be handled — except with gloves. It should be left with the dam for at least a day so that it will be licked clean by the dam.

In a vaccinated herd the within-herd spread of Brucellosis can be completely prevented by using the information given above.

The only time there is any significant risk of spread of infection on the farm is at or near the time of parturition. Almost all the attention should be focussed on this.

For the present, in the pre-intensive area, it is most important to keep the spread of disease to a minimum. In doing so, Brucellosis can be virtually eliminated without too much financial strain.

At the commencement of 1981 it is expected that compulsory eradication measures will come into force. These can prove economically disastrous if there is much infection left in the herd. Most herds clear up rapidly under intensive measures but some, particularly the larger herds, may experience difficulties.

It is not a simple process to finally get rid of the last pockets of Brucellosis infection in a country. But the means to do so are available and with farmer co-operation they will succeed. The total eradication of Brucellosis is worth working for—and it is something that can definitely be achieved.

New growth.

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Financing the Dairy Industry in the Future

P. MacCANNA

Chief Agricultural Adviser, Bank of Ireland, Dublin.

In the recent past, we have emerged from a particularly buoyant period of credit sufficiency, good prices, unprecedented windfall gains, and a generally favourable investment climate which accommodated and encouraged an adventurous investment approach.

For those who availed of the opportunity, it was a time which projected farming onto a new and higher place of deserved affluence. It was a time which the sector needed; it was a period when farmers were rescued from even the most crude management of their financial affairs by large and sometimes unexpected price increases. There was little urgency in the acquisition of improved farm or financial management skills.

By contrast, we are now faced with :

- A climate of credit restraint
- Higher interest rates
- Static prices and rising costs
- Some uncertainty about the shape of future agricultural policies.

These changing circumstances have shifted the parameters and have made decisions about future investments more difficult. The year 1979 was a bad year for farming; a year which, from a borrowing viewpoint, brought home to farmers and, indeed, to lending institutions, the need for more control in the administration and use of farm credit in the future.

(A) General availability of credit

It is relevant, before we discuss investment at farm level, to look globally at the credit situation. The total amount of credit made available to agriculture in the years ahead will be shaped by three major factors :—

1. **The European Monetary System :** the stability of our economy and the degree to which the Central Bank see control of credit as an essential component in maintaining that stability.
2. **Agriculture as a sector within the economy :** its importance; the return on the investment and its overall stability. In the last five years, agriculture has clearly been a priority area in terms of opportunities for justifiable and profitable investment. The positive response by Government and lending institutions in making the necessary investment capital available was conditioned by :
   a) The undoubted potential which existed and indeed still exists in the agricultural sector for increased production.
   b) Our comparative advantages in many areas of agricultural production, particularly in the context of grassland based enterprises.

c) Price and market stability under the influence of the Common Agricultural Policy.

3. **The repayment capacity of agriculture** and the security which it offers. There was considerable surplus repayment capacity in the sector to justify a 100% increase in borrowing by this sector within the last 7 years.

The credit restrictions imposed by the Central Bank, which were understandably in the interests of the economy as a whole, were compounded by other factors, particularly the break in the link with Sterling and industrial problems in the non-Bank segment of the financial sector. These events posed particular difficulties in rearranging available resources so as to ensure an even flow of funds throughout the year.

Current indications would suggest little prospect of a significant easing in credit restrictions for 1980 and perhaps for some time to come. However, despite the overall restrictions to date, agriculture as a sector has fared extremely well. Despite the 18% credit expansion guideline for the economy as a whole in 1979, advances to agriculture increased by 25%. I confidently expect the sector to remain a priority area for scarce funds in the future. Furthermore, careful management by lending institutions should ensure that essential productive needs can be satisfactorily met throughout the year.

The Common Agricultural Policy is the foundation for much of the increased confidence evident in agriculture in recent years. Its continuation is vital if the sector is to remain a priority area and justify preferential treatment and priority access to scarce funds. Therefore, I will refer briefly to the Common Agricultural Policy and my current perception of its likely development and impact in the immediate years ahead.

(B) Future development of the C.A.P.

Current political and media comment might tend to suggest that complete disintegration of the C.A.P. is imminent. However, when looked at dispassionately, this viewpoint gives a rather imbalanced reflection of the real situation.

In reality, external political issues and frustration with the lack of progress in developing other Community policies play as important a role in the current controversy as do any internal deficiencies in the C.A.P. as an institution.

A realistic view of the future development of the C.A.P. demands rational assessment of the many complex interacting issues, some of which demand change, while others strongly favour retention of the status quo.

I see the critical influences which will determine the future development of the C.A.P. as follows :

(1) Negative pressures

— Existing limits of the Community's so called 'own resources', as determined by the current ceiling of 1% VAT receipts, are likely to be reached later in 1980 or early in 1981.

- The British problem, whereby the UK is calling for a contribution to the Community Budget more in line with its receipts from the Community, is exerting significant downward pressure on EEC expenditure, particularly in the agricultural sector.
- The European Parliament is engaging in a degree of muscle-flexing in an effort to gain more control over Community agricultural expenditure. These tactics are tending to disrupt the day-to-day financial operations of the C.A.P.
- Community enlargement through the accession of Greece in 1981 and possibly Spain and Portugal at a later date could lead to a further dilution of the funds available to meet the needs of an expanded agricultural sector in the Community.
- Current international developments, particularly the recent deterioration of the US/USSR conflict, have market implications for certain food products. Maintenance of prices for these products may necessitate increased Community support in an already delicate budgetary situation.
- Structural surpluses, particularly in the dairy sector, are absorbing an increasing proportion of dwindling Community resources.
- Growing consumerism.

(2) **Positive influences**

- The Common Agricultural Policy is central to the continued existence of the European Community as a coherent unit. At the present time, the C.A.P. is the most developed and arguably the only fully fledged Community Policy in existence.
- The EEC Commission accepts the need for an agricultural policy incorporating a system of supports and safeguards for farm incomes if the Community ideal of efficient family farms is to be attained.
- Removal of support could mean the movement of 3-4 million people off the land, adding to an already serious unemployment problem.
- The dynamic nature of agriculture itself is likely to betray the transient nature of current market problems. Factors such as disease, the international economic and trading climate and in particular, weather, all have a significant influence on the nature of agricultural production so that within three or four years, the current dairy surplus is likely to be supplanted by problems of a totally different nature.
- Ireland is by no means alone in its defence of the C.A.P. Other influential Community partners, particularly France, have expressed solidarity in the objective of maintaining the C.A.P. more or less in its present form.
- The strength of the farming lobby, not alone here in Ireland, but particularly in Germany and France must be recognised as a formidable force in promoting the continued existence of the C.A.P. in its present form. Farmer power and influence is usually

disproportionate to the numerical strength of farmers in the overall population.

— The total commitment of all our political representatives to the maintenance of C.A.P.

Although some modifications are inevitable, current evidence would suggest that the essential elements of the Common Agricultural Policy will survive. Future modifications are likely to reflect changes in emphasis and operational details rather than in the fundamental character of the Policy which is likely to remain more or less intact as the cornerstone of all Community initiatives.

In the Irish situation, possible adjustments to the Policy, particularly in relation to the dairy sector, may have some effect on the repayment capacity of existing borrowers. However, I am satisfied that at both the production and processing levels, there is sufficient scope for improved output and efficiency to offset the financial effects of any likely refinements in the C.A.P.

While the future environment in the agricultural sector will demand more stringent loan appraisal and financial control, I believe that a commitment to the financing of further development is fully justified by the overall opportunities for profitable investment which still exist in the industry.

As a Bank, we are aware of the opportunities that exist in the sector for additional low risk investment justifying the sector as a priority for allocation of available credit.

(C) Investment issues in dairying—taxation

Taxation and other factors are causing some confusion in farming at the moment. In relation to the investment options that exist, recent surveys by some Co-operatives suggest that some farmers are thinking of reducing milk output, other farmers are considering cessation of milk production altogether and taking advantage of the Dairy Herd Conversion Scheme.

Income taxation is a new variable in Irish farming and is one which will continue to exert an influence on farm investment decisions throughout the 1980's.

Table 1
Family farm income *

	<£2000	£2000-£5000	£5000-£8000	>£8000
All farms	50%	30%	20%	
Full-time farms	24%	36%	18%	22%

* 1978 Farm Management Survey

Table 1 shows the percentage of farms in the various income categories for 1978. The majority of farmers can intensify without taxation becoming an issue. For farmers for whom taxation is currently an issue the following points are relevant.

(a) Income will **never** be increased by cutting back output while the value of marginal (additional) output exceeds marginal costs.
(b) Taxation will **reduce** the marginal income from a given level of production to an extent which varies in accordance with the marginal rate of tax which it attracts but will **never** eliminate it.

This reduction is more serious for the larger, higher income, higher tax bracket farm and gives rise to two separate types of decisions based purely on utility criteria:

(a) Decisions in relation to future expansion.
(b) Decisions in relation to possible contraction.

Decisions to/not to expand

It is important here to repeat a point which I made at a meeting of this Association in 1975: "that from an economic point of view a decision not to expand from say a 50 to a 70 cow unit and incur the capital expenditure involved in reorganised milking facilities, extra buildings, extra stock, etc. is an absolutely different one to a decision, once one has made the investment, to reduce stock numbsrs from 70 to 50 and leave fixed investments on which loan repayments are being made, under utilised". I can think of no situation where on strictly economic grounds such a cut-back could be justified.

In considering expansion, the degree justified will depend on the question "At what point will the additional effort and risk involved in future expansion not be justified by the after-tax return to such expansion?" Farmers with an income level being taxed at the higher rates will generally reach that point at an earlier stage than those with lower income levels and lower marginal rates of tax.

We must accept that a tax regime, by reducing the marginal return, will reduce the level of intensity at which the more commercial high income farmer will ultimately farm.

Decision to change system (Dairy Herd Conversion Scheme)

This Scheme has a limited application to the Irish dairying sector. Its application is strictly for farmers who have large acreages; a tillage option; mediocre performance or some particular personal circumstances which might justify the decision. For farmers who do not have a tillage option and who would have to rely on the substitution of a low income drystock farming system, the Dairy Herd Conversion Scheme has no place.

Again, for the smaller farmer where the attainment of an income to provide a reasonable standard of living is the objective, the Dairy Herd Conversion Scheme is **not an economic option.**

With the increase in the number of farmers paying tax on accounts we should be wary not to pursue tax minimisation as an end in itself through indiscriminate or marginal investments, particularly in elaborate machinery and buildings. The UK experience has shown that the introduction of taxation on accounts gave a boost to investment in buildings and machinery, obviously with a view to minimisation of tax. This false strategy was pointed out recently by no less an authority than Mr. Arnold Christensen, President of the British Grassland Association. He emphasised the danger of such a strategy. His priorities were investments not in depreciating or wasting assets but, rather investment in wealth creating assets, particularly stock. One must however in making this statement point to the need for substantial additional investment by many farmers in basic building structures.

Desirable tax incentives

Whatever the future shape of the taxation regime, there is a need for incentives to encourage investment in stock as a priority. A considerable proportion of investment over the last four/five years has been infrastructural with little direct impact on direct output. Therefore, special treatment is required for such investment since stock is not a self-liquidating asset like machinery or buildings. This characteristic of stock tends to lead to constraints if increased investment in stock is taxed as current income.

(D) Cost of credit—minimising annual repayments

Current high interest rates are a major deterrent to investment in all sectors. Strategies, which will minimise the total cost of servicing loans, can be adopted.

(1) Use of overdraft

The first facility which should be used to the optimum level is the overdraft. Typically, £1,000 which can legitimately be transferred from term loan to a justifiable overdraft reduces annual commitments by approximately £120. This is due to a lower interest rate and to the fact that the average utilisation of overdraft is approximately 66%. However, the account must revert to credit for at least 30 days in the year. The use of overdraft to the limit justified by cash flow can effect considerable savings.

(2) Length of term loan

There is some scope for reducing annual repayment commitments by lengthening terms of loan. However, there is a limitation to this and Table 2 shows that at high interest rates, there is little advantage in going

Table 2

Repayment of £10,000 term loan at present interest rates

Term of loan years	Rate of interest	Annual repayments	Total repayments
5	17	3,048	15,250
10	18	2,191	21,910
15	18¼	1,968	29,520
20	18¼	1,929	38,580

beyond a 10-year term when one takes account of the total repayments which have to be made.

When the profile of borrowings are short term, say under five years, difficulties can be alleviated by adding a few extra years to the term of the loan However, where borrowings are already relatively long term, say 8-9 years, little advantage can be gained from further lengthening the term of loan.

(3) **Leasing—relevance**

Leasing also has certain attractions for farmers who cannot utilise their full capital allowances. The following points are relevant :

- The advantages of leasing are very sensitive to the ultimate tax regime for farmers and each case has to be assessed in the light of individual circumstances.
- It enables farmers **not** in the tax net to benefit from lower interest charges, since leasing agencies can claim tax credits through depreciation allowances.
- If the notional system continues in some form, farmers under such a system with total interest payments in excess of the normal interest allowances (currently £2,400) could benefit in a similar way to those not in the tax net.
- Leasing releases capital for alternative uses.

(4) **Foreign currency**

Foreign currency has considerable attractions in terms of reduced interest charges. However, this advantage must be balanced against the exchange risk inherent in foreign currency borrowing. This risk can be covered or insured against in the case of exports which provide foreign currency receivables. This is a mechanism which has been widely used by agribusiness. Bank of Ireland has written some £30m in foreign currency loans for agribusiness in 1980.

At farm level, the application of foreign currency borrowing poses some problems, unless the Government is prepared to underwrite possible exchange losses. However, special circumstances do occur, for instance, where the risk of exchange loss can be minimised and substantial savings in terms of interest can be made. Under the Cattle Over-Wintering Foreign Currency Scheme introduced in 1979, Bank of Ireland has advanced the equivalent of approximately £IR10m which is currently attracting an interest rate of $10\frac{7}{8}\%$ as opposed to 16% and over for domestic currency borrowings, if available.

Foreign currency lending is a relatively new development in Irish banking and more widespread adoption will demand further adaptation and improvement of current lending mechanisms. In this competitive world we will be constantly searching for ways in which it can be used to benefit the whole economy and particularly the farming sector.

(E) **Investment decisions in dairying—efficiency**

Repayment capacity in dairying has been reduced considerably by the price/cost squeeze and the prospects of a more rigorous tax regime on

some farms. The importance of improved technology as the basis for maintaining or increasing repayment capacity has been stressed many times. Table 2 which shows the vastly increased repayment capacity of an 850-gallon cow herd at a stocking rate of 1.2 as against the more traditional herd of 600-gallons with a stocking rate of 1.5/1.8.

Table 3
Importance of good technical performance—60 acre dairy farm

	600 gallons/cow		850 gallons/cow	
Stocking rate	1.1	1.5	1.1	1.5
Available to meet repayments	£3631	£1368	£7459	£3652
Borrowing capacity (10 yr. term loan @ 18%)	£16500	£6250	£34000	£16500

The break-even yield which is necessary to justify a certain level of borrowing will depend on the particular investment to be made. Dairy farm investments fall into three broad categories :

1. Cases where buildings and milking facilities are adequate and expansion requires investment only in additional stock.
2. Cases where expansion requires investment in stock and buildings, but milking facilities are adequate for the larger herd.
3. Cases where expansion requires investment not only in stock and buildings but also in new milking facilities to accommodate the expanded herd.

Table 4 gives an indication of the average borrowings per additional cow added to the herd in each of these three situations and gives the approximate yield per cow necessary to justify the investment, assuming all funds have to be borrowed. It highlights once again the importance of a high technical performance, particularly where substantial levels of fixed investment have to be made.

Table 4
Expansion from 30 to 50 cows

Investment required		Yield required
A.	Cows only	500-550 gals.
B.	Cows + extra Accommodation	650-700 gals.
C.	Cows + extra accommodation New milking parlour	800-850 gals.

(F) Some guidelines on borrowing—the implications

For planning

Priorities must be carefully considered and the emphasis must be on productive investment. For people with limited repayment capacity, cash generating investments must be given priority, e.g. too much of the limited repayment capacity of under-stocked farms should not be used in servicing loans for drainage which will not increase cash income for three/four years. One needs to differentiate between drainage of very wet land which will not increase cash income for three/four years and the rehabilitation of land from which a crop of barley can be harvested within a year.

Building costs must also be examined. Investment in fixed assets must be matched to the immediate cash return, not the anticipated cash return three/four years hence. For example, modification of existing milking facilities as a first step would, for many, be a priority over building of a new facility. This philosophy has much relevance today to many **developing dairy farms.**

Technical performance

The importance of technical performance and its relationship with various levels of repayment capacity has been emphasised already. In planning investment requirements and estimating repayment capacity, farmers, advisers and indeed lending agencies should not budget on a high performance, simply because of a high level of commitment. In these situations, the evidence suggests that calculations which are based on these types of assumptions are unlikely to occur.

Records/financial control

The disciplines of planning, of keeping farm accounts to ensure that priorities are right, to support assumptions about expected levels of performance, and to monitor achievement of targets, are becoming essential components in the proper use of own and borrowed funds.

It is important that farmers do not become obsessed with keeping farm records for taxation purposes alone. Farm records are of **greatest value** in helping to improve the technical and financial management of the farm.

(G) Repayment difficulties

It is useful to refer to the difficulties which were created by the substantial drop in farming incomes last year. This drop in incomes precipitated liquidity problems on some farms. The cattle sector had a particularly difficult year and there were many cases where requests were made to have loan repayments deferred. Our Bank was constructive in dealing with these cases.

For a small minority who have more deep rooted problems which are now becoming apparent, I wish to emphasise the Bank's commitment to be constructive namely, taking all feasible steps to ensure the maintenance and indeed expansion of the farm business. Our commitment is to keep the agricultural sector moving as rapidly as possible and each individual farm within it. Some hard decisions may have to be taken in a small percentage of cases. The client who has a problem should use the services of his Agricultural Adviser/Consultant to analyse the situation and develop strategies to alleviate the problem.

Options open to the bank in a difficult situation

1. Where hard core has built-up in the current account : convert this to a term loan, provided the farm can meet existing and new term loan repayments.
2. Restructure term loan — some borrowings may lend themselves to being put on a longer term. However, as pointed out previously, there is little benefit in extending the term of loan for longer than ten years. In addition, the desirability of the lengthening of the term of the loan would depend on the particular project and the use of the funds.
3. Deferring repayment of principal for one year — this would be a reasonable strategy provided there was hope that the farmer could return to meeting full principal and interest repayments. **However, I would point out here that we are operating within a very tight guideline from the Cenral Bank and deferred repayments of principal reduce the capacity of the total lending system to make money available for new development which should take place.** However, despite this implication in some situations, the strategy is justified.
   The one situation which must be avoided at all costs by the Bank and indeed by the borrower is that the borrowing should start to run away from the client, i.e. that the borrower cannot meet interest, and finds himself paying interest on accumulating interest in the following years. This is a recipe for disaster.

Options open to the farmer

1. Improved husbandry : In many cases we find that within the limits of the present farming programme there is considerable scope for increasing income and repayment capacity through improved management, e.g. on the dariy farm, improved milk yield per cow, lower feed costs, better quality silage.
2. A change of system : the disposal of some drystock assets, substitution with tillage thus reducing total overall borrowings, substitution of cows for drystock, substitution of high yielding cows for low yielding cows in the herd. All these strategies can be considered.

In many cases, it is the last increment of borrowing that is causing most trouble. The nature of agriculture itself being cyclical, a good year would put most accounts back on the straight and narrow once again.

(H) Some pitfalls to be avoided in using borrowed finance

It is perhaps now relevant to deal with some of the pitfalls which farmers can encounter in dealing with the financing of their operations :

1. With repayment difficulties, face up to problems immediately and seek help from Advisers/Consultants; keep the Bank Manager informed.

2. In making a case for concession, provide supporting background information. Peope short of £10,000/£15,000 on budget, looking for concessions in 1980 and 1981, should be able to explain or prove that the flaws in the system which caused the loss in the first place can be controlled.
3. Do not finance fixed investment out of cash flow. In recent years when cash flow was good and credit not restricted farmers commonly embarked on investment in machinery, farm buildings, etc., only seeking loan facilities when the project was well underway and a shortage of cash became apparent. This is a highly dangerous practice. Repayment capacity may not exist and current credit restrictions may not allow the degree of flexibility which existed in the past.
4. Do not exceed your loan approval without first consulting with your lending institution. People have commonly exceeded their permission, particularly in the case of land purchase. These applications are examined very critically and in many cases, loans approved are the very upper limit of the repayment capacity of the client. There is no scope for exceeding it. It is extremely imprudent to exceed a loan approval without discussing the matter with your Manager.
5. There is concern about easier credit. When some farmers find it difficult to obtain credit from the major institutions, which examine applications professionally, they tend to utilise less disciplined forms of credit. When repayment capacity is tight, resorting to sources of credit which do not subject the total farming operation to critical analysis is dangerous. **The total repayment capacity of the farm must always be taken into account.**

However, the responsibility for his actions is ultimately the borrower's. Entering into substantiai financial commitments without checking on repayment capacity is likely to result in trouble. We have often been rescued from careless management of our financial affairs in recent years by windfall gains which are unlikely to recur in the future.

(I) Conclusion

Despite the current uncertainties, farmers should continue to expand stock numbers. Investment in stock, e.g. breeding heifers, is considerably more attractive now than in 1979. A reduction in the price of heifers by over £200 is the equivalent of approximately 6p - 8p per gallon, a point which should be borne in mind.

Smaller farmers have no option but to continue to expand. Current EEC proposals are not policy and, in my view, are unlikely to be accepted in their present form. Already a considerable part of the EEC's objective in curbing expansion has been achieved simply by the confusion that has arisen from the proposals.

> Farmers should, where feasible, continue to expand stock numbers. Considerable surplus land and building capacity exist on many farms.

I am satisfied that the future of the milk producer is fairly secure. By 1983/84 I doubt very much if it will be the problem issue. Agriculture is a cyclical industry and based on my experience of our 20 years in dealing with dairy farming, I would have no hesitation in recommending to the young farmer to undertake expansion of a dairy enterprise.

Credit is likely to be tight for the economy as a whole, but agriculture will remain a priority area for additional investment funds.

There were considerable difficulties last year in spreading available credit evenly throughout the year. We hope to ensure an adequate availability of funds for investment of a productive nature right throughout the year. The size of this availability will depend on the Central Bank guidelines. Funds should also be available to meet ordinary, seasonal and stocking needs.

The emphasis for the future must be on the improvement of our technical skills. More attention must be devoted to planning financial aspects of the farming business.

Finally, my view of the early eighties is one of cautious optimism. The climate for investment is considerably more attractive than that which faced many of our best farmers when they initiated dairy expansion in the mid-sixties. Overall, I would advise young farmers in similar situations to 'have a go' and we as a Bank will support them to the greatest possible degree.

ABSTRACTS

TILLERING IN GRASS SWARDS

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N ewtiller production and tiller deaths occur continuously through the season. For a brief period shortly before flowering, new tiller production ceases and the rate of tiller death increases sharply. Shortly afterwards new tiller production rates increase dramatically for a short period and the rate of tiller death declines. The new tillers produced immediately after flowering do not emerge until late in summer.

Data were presented illustrating these processes. Data were also presented relating these processes with flowering. The implications of the data for herbage production were discussed.

EVALUATION OF THE MACHINE WASHING OF HERBAGE SAMPLES CUT AT TWO HEIGHTS

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Herbage samples cut to ground level may contain soil contaminants which can lead to analytical errors. The washing of herbage samples cut to either ground level or approximately 2.5 cm above ground level was evaluated using a domestic washing machine with a counter-sunk agitator. Within the two cutting levels, samples were either not washed, or washed in cold water for 2 minutes with the excess water removed by spinning. All samples were dried, ground and analysed for percentage ash and *in vitro* dry matter digestibility (DMD) and organic matter digestibility (OMD).

Washed samples had a lower dry matter (DM) content and the same OMD as unwashed samples. Cutting height did not affect DM content of the samples, but a difference in favour of cutting above ground level was found for OMD. Both organic matter (OM) content and DMD were higher in washed samples but this depended on cutting height, where larger differences were generally found in favour of washed compared with unwashed samples cut to ground level. Samples cut to 2.5 cm above ground level were not adversely affected by washing.

It was concluded that the machine washing of ground-level cut herbage samples was an effective means of removing soil contamination without adversely affecting analysis of herbage quality components.

BREEDING RYEGRASS FOR IMPROVED PRODUCTION AND PERSISTENCE

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Cultivars of Italian ryegrass (*Lolium multiflorum Lam.*) have earlier growth in spring and give higher yield than those of perennial ryegrass (*Lolium perenne L.*). They are, however, less persistent and have shorter life span than the perenials. In order to combine the better characters of the two parents, tetraploid hybrids were produced by crossing colchicine induced polyploids ($2n=28,29,30$) of perennial ryegrass with the tetraploid cultivar 'Tetrone'. One hundred and fifteen F_2 populations of such hybrids were tested for their yield and quality in small plot (4.5×1.2 m^2) trials and compared with the cultivars 'Lemtal' (2x), 'Tetila' (4x), 'Tetrone' (4x), 'Barmultra' (4x), 'Sabalan' (4x) of Italian ryegrass and a hybrid cultivar 'Sabel' (4x). The check cultivars 'Lemtal' and 'Sabel' were replicated three times each; all the other treatments were unreplicated. The plots were sampled during 1974-'76 by cutting four times each year.

The cultivars ranked as Lemtal = Tetilia > Barmultra > Tetrone > Sabalan = Sabel in their annual dry matter yield and digestible dry matter production, the difference between the highest and the lowest yielding cultivars being 10%.

The hybrids (in their mean performance) produced 4% less annual dry matter ($P>0.05$), and 5% less digestible dry matter ($P>0.01$) and had 1.3% lower dry matter content than the mean of the six cultivars. However, the hybrid mean performance was equal to that of the cultivars 'Sabalan' and 'Sabel'. The hybrid mean quality i.e. digestibility, crude protein content, crude protein yield and seasonal production up to mid-June equalled that of the cultivars. Ten hybrids were selected on the basis of their individual yield and quality assessment, which out-yielded the parental cultivar 'Tetrone' by 2-13% in dry matter yield. Two hybrids out-yielded the control cultivar 'Lemtal' by 2% and 5% in dry matter and 3% and 9% in digestible dry matter. Five of these hybrids had 4 to 14% more dry matter up to mid-June and 3-10% more protein yield. These hybrids rated between 6.5 and 7.0 for persistence on 1-9 scale as compared to 4.9 of 'Lemtal', the cultivar with the highest persistence and 3.3 for Tetrone', the parental Italian cultivar. The selected hybrids headed 2-5 days later than cv. 'Lemtal'.

It is concluded that hybridization between Italian and perennial ryegrass at tetraploid level is an efficient technique for combining high yield and quality with high persistence.

CULTIVAR EVALUATION USING BEEF CATTLE

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Over three years, 6 ryegrass cultivars were compared in terms of carrying capacity, DM yield, DMD, content of live and dead material.

Vigor (Melle) was 8% better in carrying capacity than the standard S24 while Sabrina was only to 80% of S24. Vigor plots on botanical analysis showed higher tiller numbers than the other grasses with the highest content of ryegrass in them. Ground cover measurements taken at the time of quadrat sampling for DM yield showed that Vigor had the highest percent ground cover. The tetraploid Barpastra had lower values in November.

The regression of total animal LWG on DM yield gave an R^2 value of 74 for the equation LWG (kg/ha)=284.3 + 0.0706 DM (kg/ha).

In the silage evaluation there was no significant difference in LWG between the silages made from the 6 cultivars which were S24, Barpastra, Sabrina, Vigor, Cropper, Oakpark.

EFFECTS OF CATTLE DUNG PAT ON PASTURE DRY MATTER PRODUCTION AND QUALITY

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Most studies of mixed grazing have indicated that the benefits to production are associated with the complementary grazing patterns of sheep and cattle. This relates especially to sheep consuming the high grass areas around the cattle dung pats, which are refused by cattle. Under cattle only grazing approximately 10% of the area can be covered by dung pats, 40% of the area can be under high grass and between 35 and 75% (depending on season) of available herbage DM can be in the high grass areas.

This study was devoted to identifying the characteristics of the high grass areas. It was found that between May 11th and July 25th (which included 3 or 4 grazing cycles) these areas had two and a half times (excluding dung pat areas) greater pasture growth rate compared with low grass areas. The area apparently affected (high grass with greener colour) was about $0.2m^2$ on average which was almost six times the average dung pat area. The N P and K contents in high grass DM were 11% to 19% greater than in low grass DM but the effect on N content was only for a short period. With average contents of 3.19% N, 0.50% P and 3.52% K in high grass DM compared with 3.08% N, 0.44% P and 2.95% K in low grass DM it was found that 24% of N, 25% of P and 26% of K in available total DM can be concentrated in one tenth of the area. Under cattle only grazing, 'high grass' represents 10% to 18% of the area and about 36% of available DM and could provide 37% of N, 39% of P and nearly 40% of K.

High grass DM Ca content was on average 14.5% lower compared with low grass. Mg levels were similar in both herbages.

THE EFFECT OF WILTING AND FORMIC ACID TREATMENT ON SILAGE INTAKE AND MILK PRODUCTION BY COWS

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The effects of wilting herbage up to 30% dry matter before ensiling and the effects of applying 85% formic acid to direct cut material on subsequent silage intake and milk yields by dairy cows were examined in previous experiments. The effect of wilting to higher dry matter levels or applying acid to wilted herbage before ensiling had not been investigated. Thus, in this experiment unwilted and 36h wilted silage both with and without formic acid treatment were studied together with a 60h wilted silage.

An area of 17 ha of perennial ryegrass was divided into five equal portions, mown and harvested with a precision chop forage harvester as follows: (1) immediately after mowing; (2) immediately after mowing treated with 85% formic acid (approx. 2.3 l/t); (3) following 36h wilting; (4) following 36h wilting treated with formic acid (approx. 2.3 l/t); (5) following 60h wilting. These silages were fed *ad libitum* over a six week period to five groups of 9 early calving spring cows selected on calving date and blocked on milk yield. They were supplemented with 5.0 kg/day of a 16% crude protein barley-soyabean meal concentrate. The pH, DM% and resulting animal performance, milk yield ,kg/day), silage DM intake (kg/day) and partial feed conversion efficiencies (kg milk/1000 kg silage DM intake) were as follows: (1) 3.76, 21.2, 17.69, 1.76, 2009; (2) 3.71, 20.5, 17.98, 1.65, 2140; (3) 3.97, 28.8 17.46, 2.15, 1576; (4) 4.11, 31.4, 16.92, 2.14, 1519; (5) 4.26, 39.2, 18.28, 1.99, 1806. All the silages were well preserved. Wilting increased the dry matter content from about 21% up to 30 and 39%. Milk yield on silage (4) was significantly lower than that on silage (5). There were no significant differences between the milk yields on the other silages. Wilting significantly increased silage dry matter intake but since resulting milk yields were not significantly changed the partial food conversion efficiency on these silages was significantly lower than on unwilted material. The application of 85% formic acid to the unwilted or wilted herbage did not improve animal performance probably because in both cases the control silages were well preserved.

THE EFFECT OF WILTING GRASS SILAGE AND MONENSIN SODIUM ON THE INTAKE AND PERFORMANCE OF BEEF CATTLE

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In several experiments wilting grass prior to ensilage has increased the dry matter intake of unsupplemented silage but has not resulted in any improvement in animal performance, providing a good fermentation has been achieved in the unwilted material. An experiment has therefore been carried out to examine the effects of wilting on silage intake and animal performance and also to investigate the interaction between wilting and the feed additive monensin sodium when the silages are supplemented with barley.

A perennial ryegrass dominant sward was cut in early August and late September, 1979 after regrowth intervals of 8 and 7 weeks respectively. Half of the material was ensiled immediately and the remainder was wilted for 3-4 ways. At ensiling the unwilted and wilted herbages contained 160 and 266 g kg^{-1} of dry matter respectively. The silages were offered *ad libitum* to 48 Charolais-cross cattle (32 steers and 16 heifers, mean initial fasted liveweight 350 kg) for a period of 21 weeks. Twelve of the 24 animals on each silage treatment received a supplement of 2.2 kg of fortified barley per head per day while the other 12 received the same supplement plus 200 mg of monensin sodium per head per day. Silage dry matter intake, animal liveweight gain and carcase gain data were presented.

A NOVEL LABORATORY APPROACH TO STUDY SILAGE

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The conservation of grass for winter feed is a major component of Irish agriculture. About 12×10^6 tonnes are made annualyy. Laboratory analyses suggest that about one third or 4×10^6 tonnes are poorly preserved. The reasons for this are obscure.

The silage process is a very complex fermentation. In a study involving 152 grass cuts each ensiled in triplicate relationships between grass constituents (dry matter, water soluble carbohydrate, glucose, fructose and sucrose levels, nitrate, buffer capacity and fibre contents) were poorly related to final silage pH, with "r" values all less than 0.4.

It is proposed to study the microbiological and chemical changes during silage fermentation using a novel approach. Silage will be made in a 70 1 Mecaplex "glovebox" which will allow control of atmosphere, continuous sampling through entry ports and study of a larger sample. It is considered that this approach offers advantages over the usual test-tube "batch" system.

RED CLOVER VERSUS RYEGRASS SILAGE AS A SOURCE OF WINTER FEED FOR STORE LAMBS

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Three swards namely, a ryegrass sward (Agresso/Spirit), a mixed Red Clover/ryegrass sward and a pure red clover sward (Hungaropoly) were established in 1976 and cut twice a year over a period of three years for silage and fed to store lambs *ad libitum.* The swards were grazed by weaned lambs in autumn of 1977 & 1978. The ryegrass sward received 65-100 kg N/ha per cut while the red clover sward received none and the mixed sward received 65 kg N/cut only in the third year due to its low clover content at that stage.

Silage dry matter yields for all three swards averaged over the three years for both cuts were 9.2, 8.7 and 7.8 tonnes DM/ha/year for the ryegrass, mixed and red clover swards respectively.

Results show that red clover silage when properly preserved can be a very useful source of winter feed when fed to store lambs, resulting in high intakes e.g. 2.5% - 3.0% of body weight and producing satisfactory lamb gains on silage alone. Ryegrass silage would require supplementation with 300-450 g barley/lamb/day to achieve a similar level of performance. While it has a shorter growing season and consequently a lower yield than ryegrass, a significant saving in N fertiliser and energy conservation is achieved. In a mixed sward the contribution from red clover can be substantial, in terms of high intakes and lower N fertiliser requirements without any significant reduction in yield.

STUDIES ON THE MODE OF ACTION OF TBA AND RAL IMPLANTS IN GROWING CASTRATE MALE CATTLE

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Two metabolism and slaughter experiments using 24 Friesian castrated male cattle were carried out to investigate the mode of action of the combined implants of Trenbolone acetate (TBA) and Resorcylic acid lactone (RAL) over the weight range 250-400 kg liveweight. Control and implanted (x 2) animals were pair-fed diets of differing protein and energy levels. Responses to implantation were (kg/day LWG): Low protein diets, 0.21; Normal protein diets, 0.24; Medium energy levels, 0.25; High energy levels, 0.34. Nitrogen retention was improved in implanted animals in both experiments. Implanted animals also gave lower fat and higher meat yields and chemical analysis of the edible portion of the carcass showed significantly more water and protein and less fat.

These results are consistent with the view that implantation with TBA and RAL modifies the metabolism of the animal in the direction of increased protein synthesis and decreased fat deposition.

PELVIC SIZE AND SHAPE IN BEEF AND DAIRY BREEDS OF COWS

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In Ireland a high proportion of calves destined for the beef herd come from cows in dairy herds. With increasing emphasis on beef quality some of these calves will be sired by beef bulls. This is known to cause some increase in calving difficulty, and so it is important to understand more clearly the factors which contribute to this increase. An experiment being carried out at Grange comparing Friesian cows, Hereford Friesian crosses and Charolais Friesian crosses as mothers for single suckled beef calves provided an opportunity to study the ease of calving in these breeds. In the first year all first calf heifers were mated to a Limousin bull; in the second year one Simmental was used on all second calving animals and in the third another Simmental bull was used. In the month prior to calving pelvic measurements were made which recorded the height and the width of the internal pelvic opening. The ease of calving was then monitored according to the scale 1 for easy calving, 2 for slight assistance, 3 for difficult calving and 4 for very difficult calving.

Both pelvic height and pelvic width increased in each breed from first calving to second calving and from second to third calving. Whereas the Charolais had the highest pelvic dimensions in all years, the Hereford crosses had the second highest pelvic dimensions, and the Friesians had the least high pelvic dimensions in all years. In contrast, the Friesians had the greatest pelvic width on average in each year. The Charolais had the second widest pelvis and the Herefords the least wide pelvis in each year. Thus, the ratio of the height to width varied between breeds of dam. The pelvic height divided by pelvic width in the Friesians always gave a ratio of less than 1 indicating a pelvis which was slightly wider that it was high, whereas in both the Charolais crosses and Hereford crosses the ratio of height to width was 1.1 in each year.

The ease of calving is most easily assessed by investigating the relationship between the calf size and the pelvic area. The most effective way of achieving this is to obtain the ratio of the calf weight compared to the pelvic area (which is obtained by multiplying the pelvic height by the pelvic width). When this ratio is greater than 0.14 calving is likely to be more difficult. When all animals with a ratio of greater than 0.14 were examined it was found that less than 50% of the Charolais and Hereford cows had difficulty calving, whereas more than 50% of the Friesian cows had difficult calving. It might be suggested therefore that the difference in pelvic shape may indicate breed differences, and that the Friesian calves sired by Friesian bulls might be expected to be a different shape than calves sired by beef bulls. If this hypothesis is correct it might partially explain why greater difficulty was experienced in Friesian cows bred to beef bulls.

SUPEROVULATION IN THE COW

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The success of egg transfer in the cow depends on a predictable supply of fertilized eggs for transfer. PMSG has normally been used for superovulation, but results have been variable. A crude horse pituitary extract (HAP) has been used with success for superovulation in the sheep in this laboratory.

In this study PMSG has been compared with HAP for superovulation. Forty-four heifers were given a single i/m injection of 2,500 i.u. PMSG during the luteal phase of the cycle (days 8-12) and 39 heifers received 300 mg HAP as a single i/m injection during the same period. Forty-eight hours later animals were injected with 500 μg Cloprostenol. Donors were inseminated twice at oestrus and egg recovery attempted 3-8 days post oestrus. Mean ovulation rates of 16.5 ± 9.1 and 12.7 ± 10.6 were found for PMSG and HAP, and 7.5 and 5.1 fertilized eggs respectively.

Slightly higher ovulation rates and numbers of eggs were found in the summer months. Extending the interval from PMSG to prostaglandin injection from two to three days increased the ovluation rate (16.3 vs. 18.7) and number of fertilized eggs (7.9 vs. 9.0).

STUDIES RELATED TO EGG TRANSFER IN SHEEP

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In the first of three experiments 39 Texel ewes were heat synchronised with intravagina sponge pessaries (30 mg FGA) for 12 days. 200 mg/ewe of horse anterior pituitary extract (HAP) was administered to induce superovulation. The ewes were allocated to one of three treatment regimes (a) 50 mg HAP on each of 4 days, (b) 100 mg HAP on each of 2 days, (c) mg HAP as a single dose. The animals were bred by uterine insemination at 36-48 hrs. Mean ovulation rates of 15.0, 12.6 and 9.7 and egg recovery rates of 6.8, 5.5 and 2.2 respectively were obtained. The percentage of eggs fertilised was 47.7, 56.3 and 75.0 respectively and was significantly different between treatments. The fertilised eggs were transferred to recipient ewes and by 7 weeks 66% had not repeated.

In the second experiment 27 crossbred ewes were used to evaluate the influence of method of synchronisation on superovulation and recovery of fertilised eggs. The four treatments employed were (a) 12 day intravaginal sponge, (b) 12 daily progesterone injections, (c) 12 day sponge supplemented with four daily progesterone injections, (d) natural cycle. HAP was administered over a 4 day period and breeding was by uterine insemination using pooled semen. Mean ovulation rates of 10.6, 8.9, 8.9 and 18.2 respectively were recorded and 85.7%, 76.2%, 75.0% and 51.9% of eggs recovered were fertilised.

In the third trial, 21 cull ewes were used to compare uterine insemination with repeated cervical insemination on egg recovery and fertilisation. Pooled semen from Texel rams was used in breeding. Significant differences were found in the percentage of eggs recovered (46.0% v 78.9%) and in the percentage of eggs fertilised (77.3% v 55.3%).

SYNCHRONIZATION OF OESTRUS AND A.I. IN GILTS

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A practical method of controlling the cycle in the gilt would be of considerable economic importance. In this trial a new synthetic progestagen (Regumate) was evaluated as an oral synchronization agent. Fifty-eight cyclic gilts were fed one of three levels (0, 15, 20 mg) daily for 18 days. At the termination of treatment, half the animals in each group received either 0 or 500 i.u. PMSG. Gilts were bred at the first oestrus using one of three methods: (a) natural service, (b) A.I., (c) A.I. and 3 minute teasing with a sterile boar after A.I. Progestagen treatment had a significant effect ($P<0.05$) on the interval to heat. Overall PMSG treatment had no influence on the interval to oestrus onset.

A slightly higher but non-significant increase in ovulation rate was observed with progestagen treatment and with PMSG. The proportion of gilts yielding fertilized eggs was 89%, 74%, 56% for nil, 15 mg and 20 mg respectively.

Results would indicate that regumate can be effective a sa synchronization agent.

FERTILIZATION AND EMBYRO LOSS FOLLOWING ARTIFICIAL INSEMINATION IN THE COW

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Fertilization rate in the cow following the use of natural service or artificial insemination using fresh extended semen is normally estimated at about 90%. Calving rates, however, are reported to be closer to 50%. There are few reports on the timing of embryonic mortality in the cow. A total of 256 beef heifers was used in two experiments to establish fertilization and subsequent embryonic survival rates following the use of frozen-thawed semen. Fertilization rate was estimated at 90%. Embryo survival rates were high (93%) up to and including Day 8 but were reduced at Days 12 (56%; $P<0.001$, 16 (66%; $P<0.001$) and 42 (58%; $P<0.001$). This study indicates that fertilization failure accounted for 10% of overall reproductive failure while embryo death accounted for 30%. The major portion of this embryo death occurred between Days 8 and 16.

A further 146 heifers were used in two experiments to study the effects of progesterone supplementation (100 mg daily) or HCG administration (1500 i.u. daily) during the luteal phase on CL weight and number, circulating progesterone levels and embryonic survival. Progesterone supplementation only slightly increased progesterone level ($P>0.10$) and had little effect on luteal tissue weights ($P>0.10$). HCG administration induced accessory CL numbers (Mean ± SE, 2.18 ± 0.13) and weight ($P<0.001$) and increased progesterone level ($P<0.05$). Pooled embryo survival rates for control, progesterone and HCG groups were 54%, 71% and 64% respectively. In a further experiment with 141 dairy cows, calving rates of 65%, 73% and 57% were recorded for similar control, progesterone and HCG treatments, respectively.

THE DELETERIOUS EFFECT OF ENVIRONMENTAL CONTAMINATION ON FERTILITY IN THE DAIRY HERD

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It is well-recognised that contamination of the environment of pregnant cows is a crucial factor in the pathogenesis of bovine abortion. Consequently, control measures are designed to break the 'cycle of infection', largely by secregation of infected animals, disinfection and vaccination. By contrast, little attention has been given to the possibility that environmental contamination may lead to colonization of the genital tract of the non-pregnant cow by pathogenic microorganisms with deleterious effects on fertility.

In this communication two episodes are described which indicate that this does occur, at least when the environment is very heavily contaminated. In one herd, infertility in six cows was associated with chronic inflammatory lesions in the reproductive tract due to *Aspergillus fumigatus*. Transfer of one affected animal to a new location was followed by elimination of the infection and resolution of the lesions. In another herd, there was massive contamination of the environment by *Corynebacterium pyogenes* in discharges from purulent sinusitis in a number of recently dehorned cows. The organism invaded the reproductive tract causing severe inflammatory lesions and a marked reduction in herd fertility.

Segregation of cows with purulent discharges and disinfection should be an integral part of any programme of management for improved fertility.

SILAGE EFFLUENT AS A PIG FEED

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Silage effluent is normally an unavoidable by-product of ensiling grass in our climate. The quantity of effluent from a silo is primarily determined by the quantity of grass and its dry matter content but some additives can have an effect on effluent yield. Collection and storage of silage effluent can be accomplished at low capital cost and the material normally of pH 3.8-4.2 can be preserved with the addition of formalin (3 1/1000 1 effluent) in open tanks or by ensuring anaerobic conditions of storage.

In feeding experiments carried out with pigs, effluent was substituted on a dry matter basis for 150 g/kg of a baconer diet. The production results obtained in five experiments involving almost 400 animals indicate that the digestible energy : protein ratio of effluent and the amino acid balance meet approximately the nutrient requirements of growing pigs. In five digestibility studies it was found that the mean digestible energy content of effluent was 16.5 MJ/kg organic matter. Voluntary intake studies have shown that intake of effluent dry matter can be depressed when the dry matter content is less than 400 g/kg. Although some minerals in effluent can exceed the requirements of the pig, there was no depression in animal performance when effluent was given as a sole source of liquid.

Silage effluent has been used successfully in feeding trials on commercial farms. Feeding silage effluent can increase the fattener's margin by over £3 per pig and since enough silage effluent is produced in Northern Ireland to feed all of the 1.2×10^6 baconers produced, the potential saving for the region approaches £M4.

PROBLEMS ASSOCIATED WITH FEEDING WHEY AND DELACTOSED WHEY TO PIGS

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Whey and delactosed whey are good sources of nutrients for pigs. Their physical composition 6.5% and 30% total solids respectively means that they are of little interest to the provender milling trade.

When transferred to pig farms the storage life of whey can be very short especially in unclean tanks during the summer months. Microbial degradation by streptococci, clostridia and yeasts can release 50% of the molecular weight of lactose as carbon dioxide. An experiment at Moorepark showed that poorly stored whey contained less than 50% of the nutrient value of fresh whey.

Feeding experiments with whey demonstrated that it has a depressing effect on appetite as the quantity fed increased from 25% to 33%. Pigs on the higher level consumed 10% less feed ($P<0.01$). There was no effect on feed conversion efficiency ($P>0.05$). This result cannot be attributed to a higher liquid intake since a similar effect was observed when dried whey or whey concentrate was used.

A number of scientific papers have suggested that the salt content of whey can suppress appetite. Experiments with delactosed whey which has twice the salt content of whey substantiate this viewpoint. Adding 25% delactosed whey to the diet of individually fed pigs suppressed feed intake by 15% ($P<0.01$). With group feeding (10 pigs/pen) a similar diet resulted in 7 out of 80 pigs dying from salt poisoning. In the dietary regime, these pigs were allowed 3.5 kg water per kg of meal equivalent. The Na+Cl content of the diet was 1.95%. A similar feeding regime did not cause mortality in individually fed pigs or in group fed pigs with an *ad libitum* water supply.