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Editorial

This issue of the *Journal* brings together all papers suitable for publication up to and including the Winter meeting of November 1969.

There is a current widespread interest in beef production, and a general realization of the considerable scope for improvement in beef output. It is therefore not necessary for the Editorial Committee to explain the predominance of papers dealing with aspects of this topic.

It may occur to readers that several of the contributions to this Volume 5 have appeared in part elsewhere; we are aware of this, and realize that what is highly topical is bound to be reported by the farming press soon after our meetings. But we feel also that the recording of the original papers in full in the *Journal* gives farmers, students and others a permanent and accessible record of useful reference material.

The Editor

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Input/Output Relationship in Irish Farming

by

M. W. WALKER, B.Sc.Agric., H.Dip.Ed.

The title of this paper is, of course, a sample of the present day trend towards disguising the simplest concepts in jargon. This is in its own way one of the many restrictive practices currently in vogue to keep people uninformed, and maintain an aura of dignity and mental stature around those in the know.

Occasionally, however, jargon has its uses, and the main one is brevity—that is, to explain a fairly complex concept in a few words; and this is a case in point.

In any business, and farming is a business, albeit one generally sadly lacking the benefit of the application of good business principles, it is the output which governs the gross revenue or receipts. Thus in our context we talk about sales of milk, beef, sheep, beet, cereals or whatever.

Now just as in any other industry, there are raw materials needed as the basis from which the products are derived. The fact that here the products are derived biologically as much as technologically is of no basic or fundamental importance. Our farm is our factory floor and calves, lambs, seeds, etc. are the raw materials we fashion into output.

In order to fashion a calf into a bullock fit for slaughter, or seed wheat into next year's crop, many steps have to be taken and many expenses incurred. These are the inputs, and of course a relationship exists between input and the output it engenders.

My company, as you all know, is concerned in one of the inputs needed for all land-using enterprises—one of the inputs which is a major item of variable, or direct, cost on any progressive farm. It is not, therefore, unusual that we are keenly concerned in the relationship between inputs and outputs in Irish farming.

To be in a position to judge this relationship at achievable level, rather than at presently achieved or average level, a farm costing and development scheme was inaugurated some years ago, so that at present we are costing and planning development on a total of over 100 farms throughout the country. We did not choose special farms but we choose special farmers—those who were discontents but prepared to seek and find physical and financial advice; and when they had it to act upon it as it affected their own peculiar circumstances. Thus we have a biased sample with whom we work, and so it is that we view our work as complementary to the excellent work of the appropriate divisions within the Institute and the Department of Agriculture.

To arrive at the input/output relationship for any enterprise it must be costed; and it must be costed on the Gross Margin System where each enterprise is costed separately. Only thus can accurate input and output figures be obtained.

For this purpose the Fixed or Overhead Costs are ignored due to their difficulty of allocation. Thus rates, rent, permanent labour, machinery depreciation and running costs, electricity, 'phone, and water charges, if any, are left on one side, and only the direct or variable costs, which relate directly, and which vary in amount with the size of the enterprise, are taken into account.

Cash crops are easy to deal with since it is a simple case of so many acres yielding so much crop with a sale value of whatever it comes to. In the case of cereal crops the straw value may be included or excluded as you wish. In the case of sugar-beet the leaf value for fodder is generally disregarded if fed at home but can be included if they are actually sold. Pea haulm is another case in point. However, whatever you decide it is an easy matter to arrive at an output value per acre. The inputs associated with cash crops are seed, fertiliser, sprays, contractors' charges, casual labour costs, baler twine, etc. If you do all your own tillage operations these are accounted for in machinery costs in the Fixed Cost section of your accounts.

With regard to the input/output relationship for arable cash crops it is simply a question of seeing that adequate but not excessive costs are incurred. It is fairly well-known for instance how much fertiliser and seed are needed for optimum yield. To use less than these recommended inputs is to accept reduced yields; to use grossly more is to ask for trouble. However, even in such a straight-forward situation some form of comparator is useful and to this end we have combined experience from all our Costed Farms to provide a set of Farm Planning Standards. These give a fair idea of the input/output relationship and any farmer's own results and costs can be compared with this norm. Thus if your yield is lower than standard you can study your inputs as compared with standard inputs and some variation, if found, may account for the discrepancy. If inputs are normal you must look further for the cause of the trouble. Lime status and plant disease are two factors that spring to mind immediately.

If we examine the common agricultural cash crops in Table 1 we see that for the given yields of crop, as expected under standard conditions, the cereals fall into the financial order of superiority of Gross Margin per acre as follows:

1. Spring Wheat .... £47.4 per acre
2. Malting Barley .... £34.9 per acre
3. Feed Barley .... £28.9 per acre
4 Oats .... £27.0 per acre

In all cases a yield of 1 ton of straw per acre is included valued at £2 per ton except oaten straw which was valued at £4 per ton.

A point to note is that no contractor's charges have been included since as mentioned previously one's own machinery charges appear in fixed costs and, therefore, for comparison purposes no contract or casual labour charges are included. These are, however, direct or variable costs and if they apply in your individual case they must be deducted to arrive at your own Gross Margin.

The other two common cash crops are sugar beet and potatoes as shown in tables 2 and 3. Again if we ignore contract and casual labour charges, since these crops can be handled in so many ways, for the standard yields we expect Gross Margins of £94.1 per acre from sugar beet, and £65 per acre from potatoes. It may be interesting for cash customers to note that the direct or variable costs are in contrasting order of magnitude—£55 per acre for potatoes and £24.5 per acre for sugar beet.

So far Gross Margin Standards have given us a means of comparing individual with standard inputs and outputs. When their value in this direction has been exhausted they fulfil a second more important function in the field of farm business planning. Just as most businesses have a "product-mix", so we have in farming in most cases, and our aim should be to choose the most profitable product-mix that conforms to the various constraints that circumstances force upon us.

In its simplest terms a farmer should theoretically maximise his tillage acreage in descending order of choice from sugar beet, to potatoes, to wheat, to malting barley, to feed barley, to oats. However, he must consider such constraints as, availability of contract, availability of casual labour, availability of satisfactory contractor services, risk, personal choice, market facilities, sound rotational practice, etc. All these and more will play their part in determining the eventual tillage product-mix.

If we move on now with, I hope, a clearer knowledge of terminology and direction of energies, to the livestock enterprises we shall find that a more complex scene confronts us. I will confine my remarks to grazing livestock since non-land-using enterprises have not the same vital interest for us, and the scale of operation depends on choice and capital availability, rather than on Gross Margin per acre.

The livestock unit reminds me rather of the recently announced Ford Capri. It can be put together in many different ways and then "custom-planned" to suit your own particular farm business or way of life.

Basically though, as is shown by Fig. 1, it is the rate at which you stock your livestock units that governs the Gross Margin per acre return. If there is a profit from a beast then there is more profit from two, and if you can keep two beasts where one stood before your

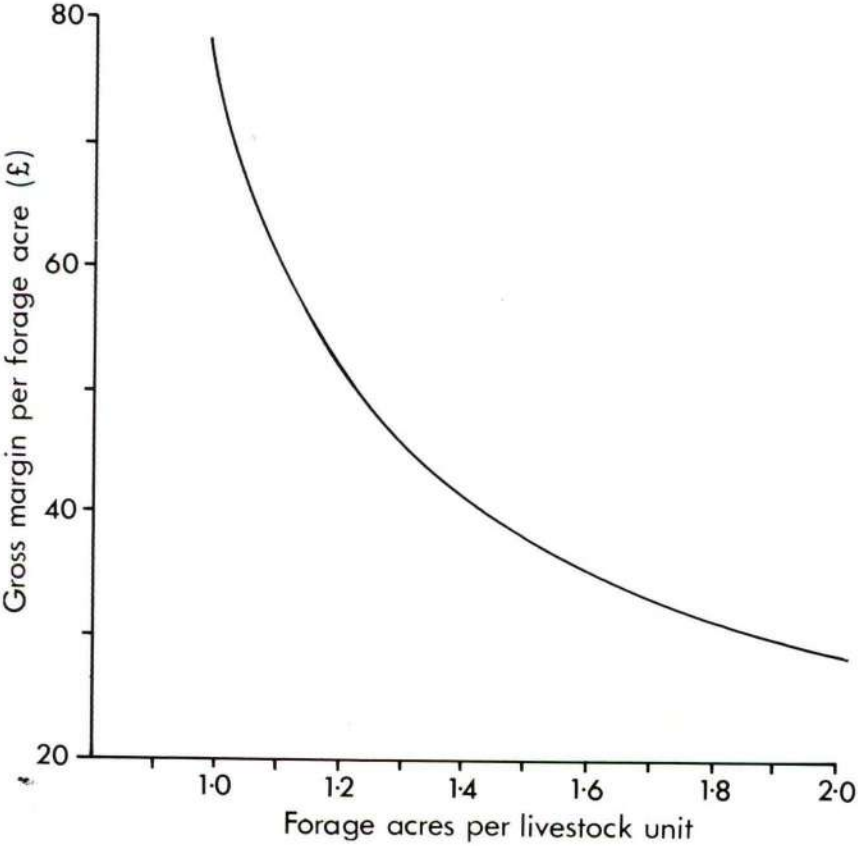

Fig. 1: Correlation between stocking rate and gross margin per forage acre (Dairy Cows 1967)

gross margin is almost doubled per acre. Of course, there will be some extra direct or variable costs, but in most cases, in the short-term, there will be little or no change in fixed or overhead cost structure. The effect on profit per acre is shown in Table 4.

The categories of grazing livestock that we have investigated are as follows: dairy cows for creamery and liquid Consumption; dairy young stock; beef cattle; and breeding sheep. Some small experience was gained in single suckling.

In the case of the dairy cow her output consists of the sale value of her milk and her calf less her share of herd depreciation, which may amount to as much as £8 or £12 per cow. Thus the output of a cow varies from year to year depending on the sale price of calves and her milk yield. Milk yield varies by calving date and feeding regime and by lactation number, but basically the inherent capacity to produce milk is innate and as such can only be varied within limits by the above factors.

Thus the output per cow is dependent on her inherent capacity to produce milk—the price of her calf and depreciation are largely out of the farmer's control.

If we refer to Table 5 we will see that for creamery cows the output can very between £77.5 and £99.7 for a 200 gallon variation in milk yield between 600 and 800 gallons taking a price of 2/5d. per gallon.

Now let us look at the cost inputs which are associated with generating this output. For a 600 gallon cow on 1.7 acres per livestock unit the inputs amount to £22.2 and for an 800 gallon cow they amount to £27.3. Thus the higher yielding cow shows an increased Gross Margin of £17.1 for no extra effort on the farmer's part. This indicates clearly the importance of yield per cow.

If we now examine the effect of stocking rate we can see that to increase stocking rate from 1.7 to 1.2 acres per livestock unit, the extra input costs incurred are only in the region of £2. However, allowing for this extra variable cost, the Gross Margin per acre goes up by almost £12. What does this mean for the farmer? It means that a herd of 20 cows can be kept on 24 instead of 34 acres. The 10 acres released can be utilised by some other livestock or tillage enterprise, or the cow herd can be expanded to 28 on the same acreage. The extra Gross Margin on 34 acres would be just over £400. Even if he has to buy 8 cows at £100 each his return is 50% on the outlay and he is working into more stock for sale from his dairy young stock or beef fattening enterprises. If he could fit the 10 acres into his arable rotation he could make an increased Gross Margin of £500, but as we have already pointed out this does not allow for contractor or casual labour charges which would reduce this figure. However, there would be no capital investment in cows. This is where the farmer must choose, bearing in mind risk, personal choice and any other relevant factors, such as availability of capital, housing limitations, etc.

A brief run through Table 6 on dairy cows producing milk for liquid consumption will show that inputs per cow range between £31.5 and £36.5 per cow between yields of 700 and 850 gallons. At a stocking rate of a cow to 1.4 acres the gross margin per acre ranges between £52 and £62 at an average price of 2/10d. per gallon. By stocking at 1.2 acres per cow and allowing extra forage costs of £3.5 this gross margin can be raised to £70 per acre for an 850 gallon cow.

Table 7 for beef cattle will show the gross margin per acre achieved from overwintering and summer grazing systems. You may argue with the prices per cwt. and the liveweight gains as set out, but by making your own alterations you can use this as a blueprint for your own particular case.

Table 8 on breeding ewes indicates that the gross margin per ewe is about £5.5 and if stocked at $3\frac{1}{2}$ per acre this represents over £19 per acre gross margin. This is a most attractive return on capital.

Table 9 is, I think, of considerable interest. It concerns the sort of gross margin one could expect from intensive beef rearing and feeding. Again you may argue with the figures, but these are actual. If cost of calves seems low, so too does the sale value at that weight. The difference—the output—is about right. This enterprise could prove most attractive to anyone who had intensified his dairy herd to raise gross margin per acre, and who was looking for a profitable grazing livestock enterprise to absorb the released acres. It has the advantage that in many cases the calves are available on the farm. Thus capital is not needed—one simply has to forego the immediate cash income from sale of calves. However, once the scheme is in operation, cash flow is unimpaired. Even if capital is needed it should not be much more expensive to stock with calves than with cows and housing and handling costs would probably be less.

In the time available I have tried to cover the main farming enterprises and to give, particularly, some idea of how to go about examing the input/output relationships on your own farms. So many factors govern the eventual choice of programme on any individual farm that specific information is impossible. I would suggest however that with the aid of standard gross margins you could plan your own input/output relationships. When a pattern has been chosen the fixed and working capital positions can be determined and the expected return on capital can be forecast with some degree of accuracy.

Table 1
CEREALS

			A	B	C	D
			Wheat	Feed Barley	Malting Barley	Oats
			Per acre			
Physical Data	Yield	cwt	32.5	30.0	28.0	26
	Fertiliser use	N units	30.0	25.0	25.0	18
		P units	30.0	25.0	25.0	36
		K units	60.0	50.0	50.0	54
	Seed rate	stone	10.0	8.0	8.0	12.0
			£ per acre			
Output			58.9	38.0	44.0	36.5
Variable Cost	Seeds		4.5	3.0	3.0	3.0
	Fertiliser		5.0	4.1	4.1	4.5
	Miscellaneous		1.0	1'0	1.0	1.0
	Spraying (Materials only)		1.0	1.0	1.0	1.0
		Total	11.5	9.1	9.1	9.5
Gross Margin	(No casual labour employed)		47.4	28.9	34.9	27.0

Table 2
SUGAR BEET

			Per acre
Physical Data	Yield	tons	15
	Fertiliser use	N units	60
		P units	90
		K units	240
	Seed rate	lb	6
			£ per acre
Output	(15 tons @ 16% sugar)		118.6
Variable Cost	Seed		2.5
	Fertiliser		16.0
	Miscellaneous		6.0
		Total	24.5
Gross Margin	(No casual labour employed)		94.1

Table 3

POTATOES (Maincrop)

As potato sale price is so liable to fluctuate; an average price of £12 per ton is being used

			Per Acre
Physical Data	Yield	tons	10
	Fertiliser use	N units	60
		P units	50
		K units	150
	Seed rate	cwt	20
			£ per acre
Output	(10 tons @ £12 ton)		120
Variable Cost	Seed		30
	Fertiliser		13
	Spray Materials		7
	Other including Packaging		5
		Total	55
Gross Margin	Contractor charges and casual labour excluded		65

Table 4

Effect of Stocking Rate on Profit per Acre

Area	Stock (cows)	Gross margin (per acre)	Fixed Costs (per acre)	Profit (per acre)
2 Acres	1	£27.5	£20	£7.5
2 Acres	2	£50	£20	£30

Table 5
DAIRY COWS (Creamery)

Comparison of 2 levels of stocking density at 2 levels of milk yield, to indicate the importance of a high stocking rate to obtain a high high Gross Margin per acre			A	B	C	D
			Mod. Yield Low Stocking	Mod. Yield High Stocking	High Yield Low Stocking	High Yield High Stocking
			Per Cow			
Physical Data	Yield	gal	600	600	800	800
	Conc. per gal.	lb.	0.8	0.8	1.0	1.0
	Forage Area	acres	1.7	1.2	1.7	1.2
	Concentrates	cwt.	4.3	4.3	7.1	7.1
	Silage	cwt.	120	120	120	120
	Milk per forage acre	gal.	353	500	471	666
	Milk per forage acre net of meals*	gal.	282	400	353	500
			£ per cow			
Output	Milk Sales**		72.5	72.5	96.7	96.7
	Value of calves born		14.0	14.0	14.0	14.0
	Herd depreciation		9.0	9.0	11.0	11.0
		Total	77.5	77.5	99.7	99.7
Variable Costs	Concentrates		7.7	7.7	12.8	12.8
	Vets. and medicines		1.5	1.5	1.5	1.5
	Other costs incl. bedding, bulky foods, A.I., dairy stores		5.0	5.0	5.0	5.0
		Total	14.2	14.2	19.3	19.3
Gross Margin	Forage costs not deducted		63.3	63.3	80.4	80.4
Forage costs	Grazing, silage, hay, roots, etc.		8.0	10.0	8.0	10.0
Gross Margin	Forage costs deducted		55.3	53.3	72.4	70.4
	Gross margins per forage acre used by dairy cows.		32.5	44.4	42.6	58.7

*A deduction is made of 1 gal. for each 4 lb meals.

**Based on milk price of 2/5d. per gal. from Goulding Farm Costing Scheme figures.

Table 6
DAIRY COWS (Winter Milk)

			A	B
Autumn Calving Herd			Mod. Yield Med. Stocking	High Yield Med. Stocking
			Per Cow	
Physical data	Yield	gal.	700	850
	Conc. per gallon	lb.	1.5	1.6
	Forage area	acres	1.4	1.4
	Concentrates	cwt.	9.4	12.1
	Silage	cwt.	120.0	120.0
	Milk per forage acre	gal.	500	633
	Milk per forage acre net of meals*	gal.	312	380
			£ Per Cow	
Output	Milk Sales**		99	120
	Value of calves		15	15
	Herd depreciation (less)		10	11
	Total		104	124
Variable costs	Concentrates		17.0	22.0
	Vet. and Medicines		1.5	1.5
	Other costs incl. A.I., bedding, bulky foods and dairy stores		5.0	5.0
	Total		23.5	28.5
Gross Margin	Forage costs not deducted		80.5	95.5
Forage Costs	Grazing ,silage, hay, roots etc.		8.0	8.0
Gross Margin	Forage costs deducted		72.5	87.5
	Gross margins per forage acre used by dairy cows		51.8	62.5

*A deduction is made of 1 gal. for each 4 lbs meals (28 gals. per cwt. meals).
**Price 2/10d. per gal., Goulding Farm Costing Scheme average for liquid milk.

Table 7
CATTLE

			A Winter feeding on Silage and Summer Grazing Oct.-June	B Summer Grazing only March-Aug.
			Per Head	
Physical data	Average liveweight at purchase	cwt.	7	7
	Price per cwt. at purchase	£	9	10.5
	Average liveweight at sale	cwt.	9.25	10.5
	Price per cwt. at sale	£	10	9
	Silage fed	tons	5	—
	Forage area	acres	0.66	0.66
			£ Per Head	
Output	Sale price		92.5	95.0
	Less purchase price		—63	—75
		Total	29.5	20.0
Variable cost	Variable Costs of forage		6.0	5
	Miscellaneous		3.5	1
		Total	9.5	6
Gross Margin			20.0	14.0
	Gross margin per Forage Acre		30.0	21.0

When a general all-year-round beef enterprise is found. the Goulding Farm Costing Scheme indicates that a Gross Margin of about £23 per acre may be expected.

Table 8
SHEEP

		Breeding Flock
		Lowland
Physical Data	Lambing ... ... %	140
	Concentrates per ewe ... ... cwt.	0.3
	Average price of culls ... ... £	4.0
	Ewe mortality ... ... %	5
	Ewes per forage acre	3.5
		£ Per Ewe
Output	Lamb sales	8.0
	Wool Sales	1.0
	Less Flock depreciation	0.5
	Total	8.5
Variable Costs	Concentrates	0.5
	Vet. and medicine	0.3
	Miscellaneous	0.2
	Total	1.0
Gross Margin	Forage costs not deducted	7.5
Forage Costs	Grazing, Silage, Hay	2.0
Gross Margin	Forage Costs deducted	5.5
	Gross Margin per forage acre	19.2

Table 9
16 Month Beef from Spring-born Calves (1968-'69)
Data per Beast

		£	£
Output	Sale Value		73.6
	Cost of Calf		15.2
			58.4
Variable Costs	Rearing, Forage Costs, Meals at Grass, Vets. and Medicines, etc. (first grazing season)	12.8	
	Silage, Meals, Bedding, etc. (winter period)	10.0	
	Forage Costs (second grazing season) ...	3.0	25.8
Gross margin			32.6
Beasts stocked at 1½ per acre—Gross Margin per acre			48.9
Purchase weight (lb) 100 Sale weight (lb) 967 Liveweight gain per day (lb) 1.8			

"Beef Performance and Profitability"

by

Dr. H. K. Baker

Deputy Director (Livestock) Meat and Livestock Commission

Sources of U.K. Beef

The United Kingdom's farmers produce £300 million worth of beef per annum. This represents about three-quarters of our total beef requirement. The total consumption of beef is about 1,200,000 tons, of which some 900,000 tons are home produced. The annual consumption per head of beef is just under 50 pounds. Beef consumption does however fluctuate. Thus from 1963 to 1965 the average annual consumption per head dropped by 18 per cent from 53 to 44 lb. This decrease was made up by increased consumption of poultry and pig meat, but the consumption of beef has risen again since 1965.

The national breeding herd consists of about 3,200,000 dairy cows and 1,200,000 beef cows. In addition, between 500,000 and 750,000 live store cattle are imported annually from Ireland for fattening.

At the moment just over 40 per cent of our home-produced beef comes from dairy herd calves and about 20 per cent from suckler calves. In addition, 17 per cent comes from imported Irish store cattle. The remainder is made up of slaughtered culled breeding cows.

The most important single source of supply is the by-product calves of the national dairy herd. The majority of these are either pure bred Friesian male calves or beef cross Friesian male and female calves. About one third of the national dairy herd consists of Ayrshire and Channel Island cattle. Most of these calves have in the past been slaughtered at birth although more of these cows, not required for breeding, are now crossed with the Charolais through the use of Artificial Insemination. These cross-bred calves from the lighter dairy breeds are usually reared under intensive feeding systems.

Approximately one fifth of our beef comes from the commercial suckler herds and there has been an overall expansion in these herds during the 1960s.

In 1967, 3,592,000 cattle were slaughtered for beef. Even a small improvement in profitability or meat yield per animal can therefore have a major effect both on the overall farm income and on the total amount of beef which is produced in the United Kingdom.

Recording

In the United Kingdom feed accounts for at least two-thirds of the cost of producing the final beef carcase and in all our beef systems there is a close relationship between daily liveweight gain, the efficiency of food conversion, the food cost per pound of liveweight gain and the overall profitability. Thus even within the same type of beef production system the feed costs per pound of liveweight gain will range from 1/- to over 4/-. This indicates the wide range in efficiency which exists within beef enterprises and also highlights the scope for improvement.

British farmers have become far more cost conscious in the past few years. Individual farm enterprises have been more carefully costed and this has emphasised to farmers the low levels of profitability in beef production generally and in the traditional beef system in particular. In addition, the relationship between performance and profitability is being recognised. As a result of this, there has been a marked swing to more intensive methods of production and more cattle are now being slaughtered before two years of age.

Within all commercial beef enterprises there is a close relationship between performance and profitability. Beef recording on commercial farms can be used as an aid to management and as an indicator of the target levels of performance which must be achieved within the different systems if beef production is to be profitable.

The potential for growth of beef cattle is strongly inherited and this means that the development of recording schemes for pedigree cattle will provide an important method of selecting future breeding material.

The B.R.A. was established in 1964 to encourage and develop all aspects of beef recording and improvement. In October 1968 the newly constituted Meat and Livestock Commission assumed responsibility for livestock improvement work in Great Britain on beef cattle, pigs and sheep. Altogether about 1,700 beef producers and breeders are now recording with the MLC.

On-the-farm pedigree recording schemes

On-the-farm recording schemes are operated for all beef and several of the dual purpose breeds. The scheme involves weighing cattle to obtain weights at predetermined ages, e.g. 200, 300, 400 and 500 days. Over 40,000 pedigree weight records are being handled per annum and over 40 per cent of beef bulls licensed now have authenticated weight for age information.

Each of the breed recording schemes provides data which indicate, under the breeds' normal conditions of rearing, the average level of breed performance and the range within herds. When sufficient data have been accumulated it is possible to identify the overall effect of season of birth, age of dam, sex of calf, and level of rearing on performance. This information is valuable when comparing groups of progeny from different sires within a single herd. The combination of calf type within each group (e.g. from young or old cows and of different sex) can be corrected to a standard calf. This enables a more realistic comparison to be made of the progeny groups.

The data which have been collected in this country over the past three or four years have enabled the contemporary comparisons of progeny within pedigree herds. These results have shown that sires which are 100 lb. above the herd average weight at 400 days are producing progeny which are on average 22 lb. above the weight of their contemporaries at 400 days. This gives a heritability value of 44 per cent—very similar to the results which have been obtained over the past two or three decades in North America.

On-the-farm recording has emphasised the wide range in performance that exists both within and between breeds. The following table shows the range that exists in the recorded weights of pedigree Hereford cattle:

Table 1

Hereford cattle breed average weights (lb) (1963/7)

Sex	Average	Range	Top $\frac{1}{3}$	Bottom $\frac{1}{3}$	Difference
		200 Day Weights			
Bulls	505	305-730	625	420	205
Steers	430	255-530	545	325	220
Heifers ...	420	240-580	508	313	195
		300 Day Weights			
Bulls	750	490-1,050	867	669	198
Steers	580	405-710	680	483	197
Heifers ...	550	300-755	659	458	201
		400 Day Weights			
Bulls	1,010	650-1,350	1,105	870	235
Steers	730	485-1,050	850	619	231
Heifers ...	670	470-995	800	595	205

The variation in performance is so great that even in two distinct breeds like the South Devon and Angus there is a complete overlap of performance. The breeds 400 day average weights are 1,150 and 915 lb. but within the breeds the weights range from 700 lb. to 1,445 lb. and from 630 lb. to 1,250 lb. respectively. Obviously both management and genetic factors contribute to variations from herd to herd. But even within single herds the 400 day weights have varied by over 3 cwt. for bulls kept under similar managements.

It is of course the need to provide better comparisons between bulls from different herds that has led to the establishment of central testing stations.

Central Performance Testing

The MLC are currently operating five central bull testing stations with a total throughput of 300 bulls. These are:

Centre	Breed
Aberdeen	Aberdeen Angus
Dartington, Devon	South Devon
Harrogate	Hereford and Charolais
Holme Lacy, Herefordshire	Hereford
Stoneleigh, Warwickshire	Devon, Lincoln Red and Sussex

The bulls are taken into the centres at approximately seven months of age. They are currently on test for six months and the criteria of performance is weight for age at 400 days, i.e. 13 months of age.

It must be stressed that the whole test is a period of adjustment to balance out differences in pre-weaning management and for this reason the liveweight gain during test is not taken into account. The relative ranking of the bulls in terms of weight for age shows considerable variation during the first 4 or 5 months but is relatively consistent during the last four to six weeks.

The tests have emphasised the very wide range in performance, over 3 cwt. at 400 days of age, which exists within a single breed even when management conditions are equalised:

Table 2
Results of Hereford Central Tests 1964-8
(No. of bulls per test 31 to 36)

Year	Average 400 day wt. (lb)	Range of 400 days wts. (lb)
1964/5	1,045	940-1,180
1965/6	1,055	860-1,195
1966/7	1,045	865-1,245
1967/8	1,040	910-1,240
1968/9	1,020	875-1,160

Central testing has been useful in highlighting the differences which exist within a breed—and this has been done by having a representative cross section of the breed on test. In order to achieve the maximum return from central testing it will however become increasingly important to ensure that there is adequate pre-selection of bulls before coming onto test so that only the potentially best bulls are being centrally tested. This has already been started by imposing a minimum weight for age before bulls can be considered for testing.

Fortunately there is no antagonism between selection for growth and the potential for meat production in the commercial animal. Thus there has been no correlation between conformation (as judged by breeders) and performance at the end of the performance test so that selection for performance need not result in adverse conformation changes. There is also experimental evidence which indicates that within a single breed, or type of beef animal, the animals which grow faster will produce a better type of carcase with a greater eye muscle area and a lower proportion of fat.

On current tests there has been good correlations between growth rate and feed efficiency and it has generally been assumed that the quickest growing animals will have the best feed conversion from birth to slaughter.

However, as testing in the future concentrates on the animals which are all well above average performance it may become necessary to re-examine the feed conversion efficiency of individual animals. It is likely that within breeds the rate of maturity and hence type of carcase produced will be directly related to feed conversion efficiency.

Experimentation is at present under way to study the effect of feeding single diets in the form of pellets made from chopped roughage and concentrate. If diets of this type prove successful it will be possible to consider 'ad lib' feeding of a single diet; this could add considerably to the accuracy of the tests. It would also enable consideration of group housing of bulls on test and this could in the long term simplify management and reduce costs.

The future development of central testing must be closely linked with on-the-farm recording of herds. These herd records are essential for the meaningful selection of bulls for testing and ultimately it may be desirable to test centrally groups of 4 or 5 half-brothers from a single herd. This is already being done in Canada and would obviously add greatly to inter-herd comparisons.

Progeny testing

Compared with performance testing, progeny testing is slow and relatively expensive. However, it can give a more precise estimate of a bulls breeding value for gain. Also it allows an assessment of carcase characteristics which is not yet possible in the live bull during a performance test. For these reasons progeny testing can be justified on a cost/return basis when large numbers of offspring are sired through the use of A.I. Thus even if a progeny evaluated bull only increases the average performance of his progeny by 0.05 lb. per day, if he is used to produce 15,000 calves the extra profit resulting from these calves should be over £20,000.

The British Milk Marketing Boards and the independent A.I. centres have already announced their interest in purchasing high performance bulls—if possible from central testing stations. These organisations also appreciate the importance of progeny testing their beef stud as well as their dairy bulls in order to add precision to their original selection. The Milk Marketing Boards have established Warren Farm as their central progeny testing station where their teams of purchased bulls are finally evaluated.

The MLC is also developing a scheme of progeny testing for beef bulls standing at the Independent A.I. centres. This is similar to the Warren Farm concept except that once the progeny have been brought together as calves and have been early weaned they will be reared in matched groups on commercial farms.

Commercial Recording

Three basic types of commercial recording are carried out by the MLC.

(i) *Weight Recording*

In this scheme the commerical beef breeders use the MLC's mobile weighing machines and within a few days they are given the daily liveweight gain of each animal, the average gain of each group and the average gain of different sexes or crosses within the groups.

(ii) *Weight and feed recording*

Farmers are encouraged to keep records of feed consumption so that when the weight records are returned to the farm they are also given the food cost per pound of liveweight gain. The range in feed costs, even in the same type of beef enterprise is enormous, and quite commonly will range from 1/- to 4/- per pound of liveweight gain.

(iii) *Study Groups*

The main objective in commercial beef recording is to encourage farmers to join study groups. Each study group consists of 8 to 15 producers and is based on a single type of beef production, e.g. intensive cereal beef, semi-intensive grass beef or commercial suckler calf production.

Physical and financial targets are prepared for each type of study group. These are based on both the results achieved at Research and Experimental Husbandry Farms and on the results obtained on members' farms. Gross margin costings are used throughout as these provide the fairest basis for overall comparisons over a wide scale where both financial and physical comparisons are involved.

Study Groups form focal points for the exchange of information and advice between the participating farmers, advisory services, research establishments, experimental husbandry farms and the MLC.

Intensive cereal beef production

This system normally involves pure Friesian steers which receive high concentrate feeding and the system does not include any grazing. The feed is usually based on barley (supplemented by protein concentrate), although there are often differences in the type of cereal and in the protein balance. The roughage feeding is not normally more than 2 lb. dry matter per head per day. The concentrate may either be fed ad lib or restricted.

Using data from research, experimental husbandry farms and from recording farms, the MLC has developed both physical and financial targets. These, together with results from farms, are given in Table 3:

Table 3
Targets for intensive cereal beef (Barley Beef)

	Overall daily liveweight gain, birth to slaughter	Gross margin per head (£)
MLC target	2.5	19
Farm average	2.2	14
Farm range	1.7 to 2.7	−2 to +26
Top ⅓ of producers	2.4	19

The above table shows the wide range which exists in the overall daily gain and in the gross margin per head between different enterprises practising this relatively simple type of beef production.

Semi-intensive grass/cereal beef

During the past few years there have been considerable advances in the development of beef production from grassland. Research work has shown how intensifying both the output per animal and per acre could give an extremely efficient system of beef production.

Normally, autumn born Friesian steers or Beef cross Friesian steers and heifers are used in the system. The cattle have at least one season at grass, are slaughtered at 16 to 22 months of age at a liveweight of between 580 and 1100 lbs. To achieve the required weights the animals should have an overall average daily liveweight gain of 1.8 lb. per head from birth to slaughter.

The calves are reared indoors during the first winter and turned out to grass in the spring at about 400 lb. liveweight. During the grazing season the target is to obtain a daily liveweight gain of 2 lb. from grazing alone at a stocking rate of between $1\frac{1}{2}$ and 2 cattle per acre. The cattle are grazed on a rotational system around paddocks. The grass should be no more than 3 to 4 weeks old when grazed, and topping rejected herbage should be adopted during the latter part of the grazing season.

Up to 300 lb. of nitrogen are applied per acre and surplus grass is conserved as silage or hay. Cattle are brought indoors during the winter and are fattened on a combination of the conserved fodder and no more than 6 lb. per head per day of cereal supplement.

The physical and financial targets for this type of production are given in Table 4:

Table 4

Semi-intensive grass/cereal beef

	Physical performance liveweight gain per day (lb) from birth to slaughter	Financial results gross margin (£) per head	per acre
MLC target	1.8	36	60
Farm average	1.6	26	41
Range of study group results ...	1.3 to 2.1	11 to 50	21 to 99
Top $\frac{1}{3}$ of study group results ...	1.8	37	62

The above table again shows the wide range in farm results in both performance and financial returns. As in the barley beef units about one third of the study group members are achieving the targets and several are comfortably exceeding the gross margin target of £60 per acre. The best producers are operating a beef system which is providing a useful alternative to other forms of grassland use in terms of gross margin results.

The above results have been obtained from all over the country. The range in results is again very large, but there is no relationship between geographical distribution of the results. There is however a close relationship between daily liveweight gain, stocking rate and the gross margin per acre and generally the farms with the highest liveweight gain per acre have the highest gross margins.

The most commonly used types of calves in the semi-intensive system are Hereford cross Friesian steers or Friesian steer calves. All have been used successfully in the system. Other beef breed cross Friesian and Charolais cross Ayrshire calves have also been successfully used in this system.

A contemporary comparison between pure Friesian steers and Hereford cross Friesian steers has shown that throughout the grazing season the Hereford cross will average just over 0.2 lb. extra liveweight gain per day when compared with pure Friesian steers. The earlier maturing beef cross seems to have greater resistance to adverse conditions such as cold, wet weather, or parasitic infection, and it is during these periods that the greatest difference is noted between the two types of cattle.

Commercial suckler calf production

There are over one million suckler cows in the United Kingdom—yet until the early 1960s there had been no experimental husbandry work on systems involving this type of beef production. There is certainly no place in the lowlands for the traditional extensive system where a traditional beef type cow (with a low milk yield) produced on average less than a calf a year, needed 2 acres or more per cow and where the calf grew at no more than 1½ lb. per day. However, new evidence and experience is suggesting that, particularly on arable farms in the East and the South, there may well be a place for a new type of suckler cow herd.

The cow will be a beef cross Friesian (or dual purpose type) and will have sufficient milk to support a calf growing at 2 to 2½ lb. per day. High growth rate beef bulls will be used as the final cross to give calves with a high growth potential and with the capacity to finish on relatively low concentrate diets. The cows will need to be over-wintered as cheaply as possible on rations based on straw and other arable by-products, possibly supplemented with urea. If stocked at a cow, or more, to the acre during the grazing season it is possible to achieve the target gross margin of £40 per cow and £30 per acre.

More information is needed on the best dates for calving, levels of supplementary feeding, etc. but already results from recorded commercial farms are providing valuable information in this direction. As in the other forms of beef production there are wide ranges in performance and profitability—but the enterprises in which the calves have the best daily gains also have the best gross margin results. These results are indicating that worthwhile productive systems can be developed for intensive suckler calf production on lowland arable farms.

Results from commercial farms are showing wide differences in performance both within and between herds. Within the single breed types daily liveweight gains can vary by as much as 2 lb. per head (e.g. from 0.9 to 2.9 lb. per day). There is thus enormous scope for overall improvement. It is essential that calves should grow quickly when they are suckling their dams and that they do not mature too early and hence still continue to grow during the post-weaning period.

MLC's overall programme

The MLC's plans for beef recording are based on developing a co-ordinated programme which will link together the pedigree breeder and the commercial producer.

On-the-farm pedigree recording schemes will form the base-line of the breed improvement programmes. From these will be selected the best bulls for central testing. The best of the centrally tested bulls will be progeny evaluated to select the nucleus for A.I. and it is hoped that eventually these superior bulls may also have a significant influence on the breeding programmes within pedigree breeds.

Commercial recording will continue to highlight the range of commercial results and the relationship between performance and profitability. The MLC will wish to record sufficient commercial farms to continuously assess the effects that the breed improvement programmes are having. The study groups will also play a useful role in evaluating progeny both from tested bulls within a breed and in evaluating different breeds and crosses in different systems.

Finally, it is intended that the commercial recording in study groups and the progeny evaluation work will be linked with the carcase classification work of the Commission so that there will be a complete link from the breeding work—through commercial production—to the consumer.

Intensification of Single Suckling

by

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In the past the great majority of our beef animals were obtained from dairy herds. During the last few years problems have been encountered in the export of dairy products. In general, the international markets for dairy products is seriously depressed and sales in export markets require heavy subsidies. The Government have recently introduced a beef cattle incentive scheme the purpose of which is to expand beef production without at the same time increasing commercial milk production (1). Thus, it is unlikely that in the future, the supply of calves from our dairy herds will be sufficient to meet the demand for beef animals and other sources of beef calves will be required. For this reason, information on single suckling as a potential source of beef merited investigation.

Single suckling is often referred to as been biologically in-efficient. Results from the British Grassland Research Institute at Hurley (2) and (3) would indicate, however, that single sucklers are at least as efficient as sheep when efficiency is measured as pounds of carcass produced per 100 pounds of digestible organic matter consumed. When compared with dairying, single suckling is not as efficient in the conversion of animal feed to human food.

Efficiency may be defined in various ways but one of the more useful from our point of view would be in terms of pounds of carcass (or to be more precise, lean meat) produced per unit area of land. Thus, in investigating single suckling as a potential source of beef we want to look at factors which might influence its efficiency as defined above.

Increased output could arise through:

(1) Increased summer stocking rate.

(2) Improved calf performance, and

(3) Cheaper feeding of cows in winter.

At Grange the effects of summer stocking rates and some other factors which might influence calf performance are being investigated.

Summer Stocking Rate

The animals were stocked at 1.0 (low), 1.5 (medium) and 2.0 (high) cows and their calves per acre for the grazing season on grass white clover pasture during the years 1966 to 1968 inclusive. The pastures received 3 cwt. of superphosphate, 1 cwt. of muriate of potash and 2 cwt of calcium ammonium nitrate per acre each year. The cows and calves were rotationally grazed around six equally sized paddocks. Animals were moved to the next plot when, by visual accessment, those at the high stocking rate were short of grass. The animals were removed from their treatments each year when the calves at the high stocking rate ceased making further liveweight gains. Hereford cross cows and calves were used during the three years. There were eight cows and calves per treatment.

Calf liveweight gains

1966—The cows used were all first calvers. The experiment proper did not commence until June the 2nd. However, the area was grazed from the start of the grazing season. The average age of the calves at the start of the experiment was 31 days. There was a difference in calf daily liveweight gains when the whole season is taken into consideration (Table 1). This difference is due to the poor performance of the calves at the higher stocking rates from early August until the end of the grazing season, when only those at the lower stocking rate gained at a rate of 2.0 lb. daily. No difference in calf performance was noted in the period June to August when those at all stocking rates made average daily liveweight gains of over two pounds.

Table 1
Calf liveweight gains (lb per day) 1966

	Stocking Rate		
	Low	Medium	High
June 2 to October 18	2.0	1.8	1.7
June 2 to August 4	2.1	2.1	2.1
August 4 to October 18	2.0	1.6	1.4

1967—Mainly first calving animals were again used as those from the previous year were due to calve too late in the season. The average dates of birth for the calves at the low, medium and high stocking rates were 28th February, the 1st and the 7th of March respectively.

The daily gains of the calves differed from the previous year in that those stocked at 2.0 per acre gained less than the other two groups during the early part of the grazing season (Table 2).

No difference was found between the low and medium stocked calves during this period. From August until the end of the grazing season calf performance was somewhat similar to that obtained in the previous year with only those stocked at the low rate gaining over 2 pounds daily during this period.

Table 2
Calf liveweight gains (lb per day) 1967

	Stocking Rate		
	Low	Medium	High
April 3 to October 4	2.3	2.0	1.6
April 3 to August 2	2.4	2.3	1.9
August 2 to October 4	2.1	1.6	1.0

1968—The calves on average were about 40 days old at the commencement of the grazing season on April 11.

Calf daily liveweight gains followed a somewhat similar trend to that obtained in 1966 (Table 3). No difference was found in calf performance between any of the three stocking rates during the period April to August. As in the previous two years increasing the stocking rate from August until the end of the season resulted in reduced calf gains. Only those at the low stocking rate gained over two pounds daily during this period.

Table 3
Calf liveweight gains (lb per day) 1968

	Stocking Rate		
	Low	Medium	High
April 11 to September 24	2.2	2.1	1.9
April 11 to August 1	2.2	2.3	2.2
August 1 to September 24	2.1	1.6	1.2

Cow Liveweight Changes

The liveweight changes of the cows at the various stocking rates followed a somewhat similar trend during all three years. However as the grazing season commenced later in 1966 the magnitude of the changes were not as great in that year. Table 4 shows the average liveweight changes for the cows during the 1968 grazing season.

Table 4

Cow liveweight changes (lb) 1968

	Stocking Rates		
	Low	Medium	High
April 11 to September 24	309	238	74
April 11 to August 1	277	253	190
August 1 to September 24	32	−15	−116

Despite the fact that no difference was obtained in calf performance during the period from April to August 1968, a difference was found in cow performance. The cows at the high stocking rate gained 190 lb. rates gained on average 63 lb. and 87 lb. more respectively. During the later part of the season large differences in cow weight changes were obtained, the cows at the high stocking rate lost 116 lb. in bodyweight while those at the low stocking rate gained 32 lb.

Effect of milk yield on calf performance

The milk yields of the cows were obtained periodically throughout the grazing season during all three years. Estimates of milk yield were obtained by separating the calves from the cows and then weighing the calves before and after suckling. A large variation in milk yield was found between cows within any one treatment. Looking at the 1966 data when the variation in calf age at weaning was least and milk yield was estimated more frequently than in the other two years, a comparison is made between the average performance of the calves from the four cows giving most milk in each treatment and the calves from the four cows giving least milk (Table 5). The milk yield estimates were taken at two-week intervals commencing on July 7.

Table 5

Effect of milk yield on calf performance from birth to weaning

		Stocking Rate Low	Medium	High
Milk yield (lb per day)	Best	18	16	15
	Worst	11	12	12
Calf liveweight gain (lb per day)	Best milkers ...	2.1	1.9	1.8
	Worst milkers ...	1.8	1.7	1.6

The better milkers had calves which gained on average at least 0.2 lb. more per day from birth to weaning at about 170 days. This means an extra 36 pounds at six months of age. This response to milk may not however apply if the average milk yield of the cows was higher than that found in the present work but it does indicate that a better milking cow would be a decided advantage under those conditions. It applies also for cows calving earlier in spring. When the same exercise is undertaken for the 1968 data the response in calf performance to milk was found to be even greater than that shown above. In 1968, older cows were used, their milk yields were higher and the average calving date was in early March. Results elsewhere (4, 5 and 6) also demonstrate that milk yield of the cow is a major factor influencing calf performance.

Creep grazing for the calf

Work at Grange has shown that in a rotational grazing system the digestibility of the herbage selected by beef cattle on entering a plot is much greater than that selected a couple of days later as they leave the plot (7). Due to the high relationship which exists between digestibility and intake (8, 9) one would expect that calves allowed to forward creep graze ahead of the cows would obtain a greater intake of digestable nutrients. This improved intake should manifest itself in improved calf performance. In the stocking rate work just outlined a forward creep for the calves to the plot ahead of the cows was investigated. This investigation was made at the medium (1.5 cows and their calves per acre) stocking rate only. Although the trend was for the calves to gain slightly better and the cows to make poorer gains when compared with the animals not creep-grazed at a similar stocking rate, the differences in calf performance were not significant. This investigation is now being continued in greater detail.

Double suckling

This was again investigated at the medium stocking rate only. The same procedure was adopted as described for the stocking rate trial except that in this case the calves were suckled twice daily and they grazed the plot ahead of the cows. No adjustment in stocking rate was made for the extra calf.

Calf performance was somewhat similar during all three years. The data for 1968 is shown with that of single suckled calves stocked at the same rate (Table 6).

Table 6

Gains (lb per day) of calves reared at 1 and 2 per cow at the same stocking rate (1968)

	1 calf per cow	2 calves per cow
April 11 to September 24	2.1	1.5
April 11 to August 1	2.3	1.8
August 1 to September 24	1.6	0.9

The double sucklers gained 1.5 lb. daily during the whole grazing season compared with a figure of 2.1 lb. per day for the single sucklers. A good performance of 1.8 lb. daily liveweight gain was obtained with the double sucklers until August. Thereafter, the poor performance can probably be attributed to scarcity of grass.

Finishing single suckled calves

As those calves have been reared on a high plane of nutrition in early life their finishing treatment is not likely to be similar to that of calves grown at a slower rate. Thus, an experiment was designed to obtain preliminary information on the finishing of those calves.

Single suckled Hereford X bullocks were fed at three planes of nutrition in winter and subsequently grazed together at pasture. The animals were slaughtered on reaching 1,000 lb. liveweight. Silage was fed at libitum to the three groups in winter and different levels of concentrates to the two higher plane groups (Table7).

The calves were about 630 pounds liveweight at the beginning of winter.

Table 7
Feed intake during winter

	Plane of nutrition		
	High	Medium	Low
Silage[b] (lb of D.M. per day)[a]	6.4	8.1	8.6
Meals[c] (lb per day)	8.7	4.1	—

a. oven-dried
b. Two silages were used, the change-over occurring on 4th February. The in-vivo dry matter digestibilities were 66.3 percent and 62.6 percent for silages 1 and 2 respectively.
c. 90 percent rolled barley and 10 percent soya bean meal.

As can be seen from the performance of the low plane group that received silage only, the quality of the silage was poor (Table 8). However, the response to meal was quite good, an extra 0.22 lb. daily liveweight gain per pound of meals fed was obtained at the lower level of meal feeding.

Table 8
Liveweight gains (lb per day) of sucklers in winter and at pasture

	Winter Plane of Nutrition		
	High	Medium	Low
November 14 to April 12	1.4	0.9	0
April 12 to July 3	1.5	1.9	2.8
April 12 to slaughter	1.4	1.7	2.2

No animal had been slaughtered before July 3 and the liveweight gain of the animals wintered on a high plane was only 1.5 lb. daily from the time they were let out to pasture on April 12 to July 3. During the same period the daily gains of the medium and low plane groups was 1.9 and 2.8 lb. respectively. The poor performance of the animals wintered at the high plane of nutrition on letting out to pasture would tend to suggest that those animals when fed on a high plane of nutrition from birth tend to mature at too low a weight. Thus, a breed or cross with a greater growth potential, which matures at a greater weight would appear to be beneficial. However, the hot carcass weight was greater for the group wintered on the high plane of nutrition and thus it would appear that liveweight gains may not have been a true reflection of carcass gains.

Table 9
Days to slaughter and carcass weights (lb)

	Winter Plane of Nutrition High	Medium	Low
Days April 12 to slaughter	122	154	178
Hot carcass weight	589	567	561

The number of days from April 12 to slaughter at 1,000 lb. was 122, 154 and 178 days for those wintered at the high, medium and low plane of nutrition respectively.

Future targets

The objective is to feed one cow and her calf to about a year on 1 acre of pasture plus some meals for the calf in winter (Table 10). From the information already obtained one can conclude that it is possible to get good calf performance at stocking rates of up to 2 cows and their calves per acre until August, i.e. 1 cow and her calf on 0.5 acre. Thereafter, in order to maintain calf daily gains at over 2.0 pounds the stocking rate must be reduced to about 1 cow and her calf per acre. From April to August the extra ½ acre that is required for the cow and calf unit later in the season can be cut twice for silage.

Table 10
Future targets

January and February	Calving
April to August	Pasture—1 cow+calf on .5 acres Silage—.5 acres cut twice
August to November	Pasture—1 cow+calf on 1 acre
November to April	Weanlings—silage+about 6 lb meals daily Cows—silage
Produce	One 800 lb animal

The two cuts of silage taken from the ½ acre should be sufficient to meet the requirements of the cow and the calf up to 1 year.

One should aim at producing a finished animal without having to let those yearlings to pasture for a second season. However, the weight in April would be too low and so we hope to look at methods of increasing the weight attained at this time. Some such factors as breed of bull and breed of dam will be discussed later during the meeting—both of which would have a definite role to play in increasing calf performance.

The breed of cow would be important for two main reasons:

(a) Milk yield which was shown to influence calf performance, and

(b) Imparting greater growth potential in the offspring.

At Grange, Harte (10) has shown that bulls grow faster than steers, are more efficient in the conversion of feed to carcass and have less fat in their carcasses. Thus leaving the males entire is another way in which improvement in performance of sucklers could be brought about. Of course, one can always increase the weight attained at any fixed date by calving earlier but this will increase the winter feed requirement of the cow.

However, I feel that with a calving date in January and February and using a good milking dam and a bull which imparts high growth potential in the offspring a weight of up to 1,000 pounds could be attained for the uncastrated males at 14-15 months of age.

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Mixed Stocking Versus Single Enterprise Dry Stock Production

by

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In 1963 the Land Commission leased to the Agricultural Institute a 75-acre holding at Ballintubber, Co. Roscommon. A field station was set up on this farm which is operated from Grange. When the farm was taken over the pastures would be classified as of extremely poor quality. They had been used for summer grazing with cattle and as far as was known, no lime or fertiliser had been applied in the previous years. The internal fences on the farm were quite inadequate and about 40 per cent of the total area of the farm needed drainage.

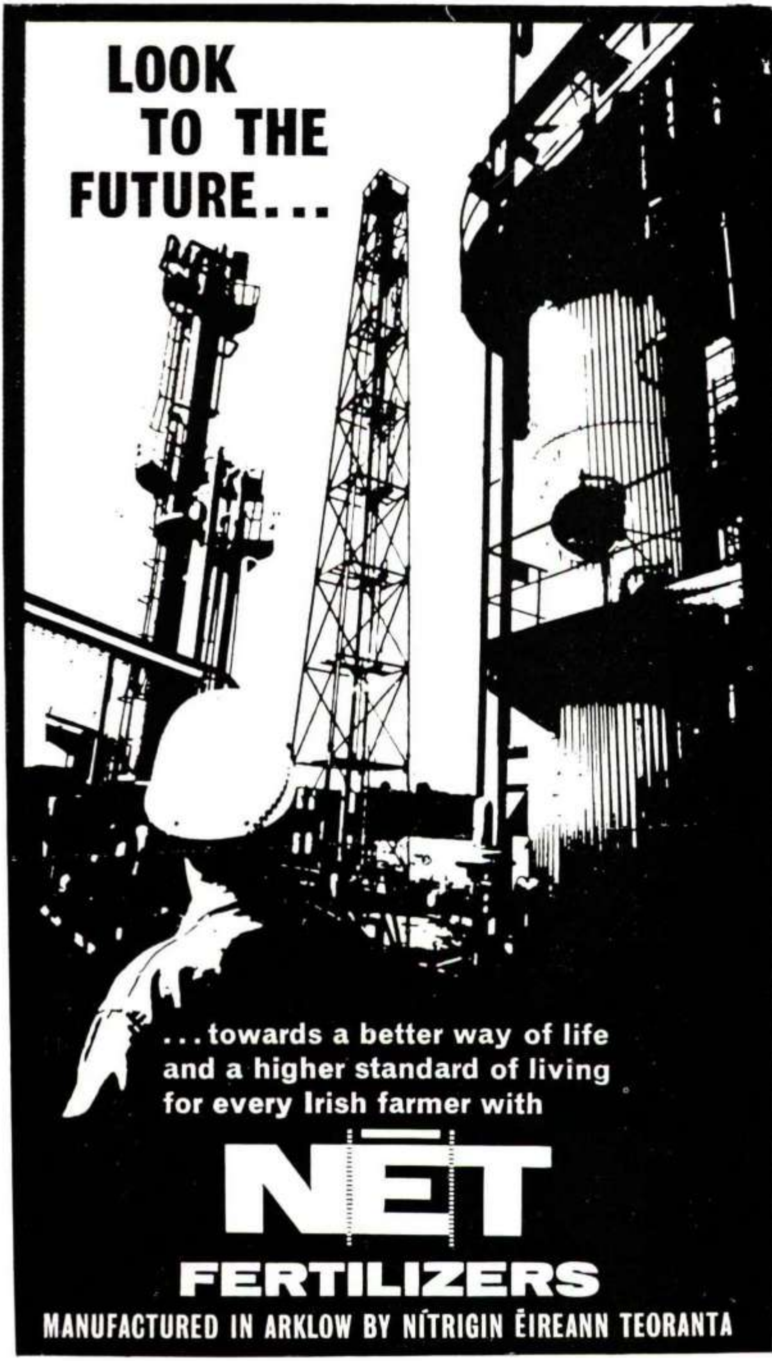
The Institute decided to use this farm to carry out research work on animal-pasture relationships. Since the area is a traditional cattle and sheep producing one a farming system of which there was very little information, it was decided that the work at Ballintubber should be primarily concerned with this field. The following questions were therefore set out:

1. What would the carrying capacity of this land be when developed in terms of cattle and sheep?
2. What sort of problems would be encountered at high stocking rates?
3. What would happen to the performance of cattle and sheep when grazed together, as compared with being grazed separately?
4. What changes would occur in poor old permanent pasture when reasonable inputs of fertiliser are given and stock numbers are increased?

The first phase of the development of the farm was the removal of the ditch fences and scrub, together with drainage. This reclamation work was done over the winter of 1963/64 but all the wet land could not be drained due to a problem with rock in one section. The whole farm was limed at the rate of 4 tons of ground limestone per acre in 1964. All areas where fences were removed or where the pasture was damaged were oversown with perennial ryegrass and white clover.

In the Spring of 1964, 50 acres was selected to lay out a trial to try and answer some of the questions set out above. This area did not include the section of the farm needing drainage.

The selected area was then divided across each soil type as follows: A—10 acres; B—15 acres; and C—25 acres.


LOOK
TO THE
FUTURE...
...towards a better way of life
and a higher standard of living
for every Irish farmer with
NET
FERTILIZERS
MANUFACTURED IN ARKLOW BY NÍTRIGIN ÉIREANN TEORANTA

The following treatments were then allocated to these three units:
A—Fat Lamb Production unit;
B—Cattle Production Unit;
C—Cattle and Fat Lamb Production Unit (mixed stocking).

Each unit was divided and fenced into 10 paddocks of equal size. Each treatment or unit was operated on a farmlet basis; all the feed for the animals for the full year (apart from meals fed to the ewes before lambing and to the cattle on silage) was grown within each unit. All units were rotationally grazed.

In the fat lamb unit the ewes were mated in October with Suffolk rams and the lambs were sold out in June, July and August. In the cattle unit yearling cattle were put out to graze in April and in November they were put into the yards and were fed on silage.
Some meal was fed with the silage. The cattle were sold out when all the silage was eaten.

On the mixed stocking unit the cattle grazed with ewes and lambs from April until weaning in early July. Whenever land was closed up for silage on either of the other two treatments, an equal area was closed up on the mixed unit.
Since one of the objectives was to ascertain the potential of this land and since the sward had never been fertilised previously, it was quite obvious that the sward would be improving every year in terms of yield. For that reason the stocking rate has been increased on all units each year as is shown in table 1.

Table 1

Stocking Rates at Ballintubber

	Fat Lamb Unit 10 acres	Cattle Unit 15 acres	Mixed Unit 25 acres
1964	35 ewes	9 cattle	35 ewes+9 cattle
1965	45 ewes	15 cattle	45 ewes+15 cattle
1966	55 ewes	20 cattle	55 ewes+20 cattle
1967	60 ewes	22 cattle	60 ewes+22 cattle
1968	70 ewes	25 cattle	70 ewes+25 cattle

There was a different method of operation for each system. In the case of the fat lamb unit, this was operated on the Grange system as set out diagramatically below:

Operation of fat lamb system

March-July	July-October			October-December	
The whole farmlet grazed by ewes and Lambs	Weaned ewes	Closed for flushing	2-3 cwt N applied-closed for silage Cut in Sept.	Rested for early grass	Ewes flushed & rams put out in Oct. Ewes graze this area until grass is eaten, then put on silage
	20%	30%	50%	20%	80%

In the early years the ewes were wintered in one paddock where they were fed silage. This worked satisfactorily but it was very muddy in some years. During the winter of 1967/68 the ewes were wintered on a sawdust pad and again in 1968/69 and it is working reasonably well. When grass runs out the ewes are fed on silage until lambing. Six weeks before lambing, meal feeding commences at ½ lb. per day, and this is gradually increased to 1½ lb./head/day just prior to lambing.

The operation of the cattle system has changed considerably over the years as the stocking rate has been built up. This applies particularly to the conservation programme. When the stocking rate was low as in 1965, it was necessary only to take one cut of silage from half of the farm, but when the stocking rate was high as in 1968, it was necessary to take two cuts of silage from part of the farm. One of the main problems in operating high stocking rate systems is the provision of enough grazing and winter feed. In the cattle system as operated in Ballintubber this is an obvious antagonism and the provision of both has to be very carefully planned. The operation of the cattle system during the grazing season of 1968 is set out diagramatically as follows:

Operation of Cattle System

April–June		June-July	
25 cattle grazing on7½ acres	7½ acres closed for silage in April Cut early June	25 cattle grazing on 9 acres	6 acres closed for second cut of silage taken in July

August–November
25 cattle grazing whole farm (15 acres)

In February a decision is made as to which paddocks will be for silage and which for grazing. Nitrogen is applied only to the grazing paddocks in February and, is not applied to the silage paddocks until April. The work at Grange has demonstrated clearly that it is possible to stock 4-4½ cwt. cattle at the rate of three cattle per acre for the period April to August. The stocking rates must then be reduced if high production per animal is to be obtained. Translating this into farm practice means that if portion of a farm is stocked at this rate that the remainder can be cut twice for conservation before the end of July and from then onwards the whole farm is grazed. This can be done provided that (1) soil fertility is at a high level, (2) pastures are rested over the winter, and (3) grazing does not start too early.

To implement this system of integrating grazing with conservation, it is necessary to do some simple planning early in the year. If the grazing animals are short of feed there are two options: (i) apply some nitrogen to the grazing paddocks or (ii) leave one of the silage paddocks back for grazing. At farm level the opposite approach is adopted towards integration of grazing and conservation, that is, all the farm is grazed early in the season and then it becomes obvious about mid-May that there is surplus grass on the farm so the decision is made to close for silage. This silage will be cut towards the end of June and since the grass will have flowered it will be of lower feeding value than May cut silage and it will not be possible to get a second cut by the end of July. Consequently, the grazing area is usually understocked in mid-summer and this necessitates a considerable amount of topping. Topping is always a good indicator of low stocking rate and poor pasture management.

Operation of mixed stocking system

April–June

7½ acres closed for silage in April. Cut early June	25 cattle and 70 ewes + lambs grazing on 17½ acres

June–July

25 cattle grazing on nine acres	6 acres closed for second cut of silage	Ewes confined to two acres	5 acres closed for ewe silage early July Cut Sept.	3 acres closed for flushing

August–September

25 cattle grazing 15 acres	Ewes confined to two acres	Ewe silage cut in Sept. from 5 acres	3 acres closed for flushing

October–December

25 cattle grazing 15 acres until November	2 acres closed for early grass from Oct.	Ewes flushed in Oct. and then access to 8 acres with grass all eaten in Dec. and then fed on silage

In our system, the cattle stay on grass until November, when they are brought into yards and fed silage with 4 lb. rolled barley per head per day. They are sold when the silage is finished which is usually late February or early March.

The operation of the mixed system is a combination of both the fat lamb system and the cattle system, as can be seen from the diagram. For example when the $7\frac{1}{2}$ acre area is closed for silage in the cattle system a similar area is closed up in the mixed system, and likewise for the all-sheep system.

The cattle for these units are reared on another section of the farm, and the system of calf rearing is similar to that developed by Dr. F. J. Harte at Grange; i.e. 50 gallons of milk substitute fed on a calfeteria system on grass with limited feeding of rolled barley.

Results

The botanical composition and plant density of the original pasture in 1963 and its composition after three years of fertiliser application and under different managements is shown in table 2.

Table 2

Botanical Composition 1963 and 1966

Species	Original sward 1963 %	Sheep (1966) %	Cattle (1966) %	Mixed (1966) %
Agrostis spp.	49.8	12.4	17.2	11.8
Sweet vernal	18.2	1.5	2.6	1.4
Yorkshire fog	6.5	9.9	14.9	9.6
Red fescue	5.1	8.4	12.0	12.5
Crested dogstail	0.3	4.1	10.6	4.4
Rough stalk meadow grass	2.2	55.5	37.5	53.3
Perennial ryegrass	0.3	2.3	1.3	1.9
White clover	6.5	4.2	7.7	3.7
Weeds	9.8	1.6	2.2	1.4
Total Plant units (sq. ft.)	558	726	748	768

The main species in the original sward was *Agrostis tenuis* or bent grass which contributed approximately 50 per cent, and sweet vernal contributed 18 per cent. The other five grass species each contributed less than 7 per cent, their combined contributon being 16 per cent. The main legume consisted of white clover and this contributed almost 6 per cent to the composition of the original sward.

One of the first effects of stock and fertiliser was to increase the density of the swards by approximately 30 per cent and there was no difference between the three systems, the *Agrostis* species were reduced from half of the original sward to approximately 11 per cent after three years. Sweet vernal was reduced from 18 per cent in the original sward to approximately 2 per cent. Weeds were reduced from 10 per cent to approximately 2 per cent.

For the grasses which improved with fertilising and management the most spectacular change was in the content of rough stalk meadow grass which increased from just over 2 per cent to almost 40 per cent in the cattle system and to over 50 per cent in the other two systems. Crested dogstail increased, particularly on the all cattle treatment, and the amount of red fescue also increased. There was very little change in the content of perennial ryegrass but the amount present in the original sward was less than 1 per cent. There has been practically no change in the clover content.

Animal Production

The percentage of lambs each year which were sold fat by weaning is shown in table 3.

Every year there was an advantage in terms of lamb growth rate with mixed grazing. Mixed grazing did not have any adverse effect on cattle liveweight gain, and in fact the liveweight gains were higher on mixed grazing every year except 1964. The performance of the cattle on summer grazing has been fairly consistent except in 1966/67. It will be noted that the liveweight gains during winter have been improving (Table 4). This can be attributed mainly to improved quality silage which was achieved by cutting at the right time.

Liveweight gains per acre have been improving every year (Table 5). This has been due to improved pastures and to increasing stocking rate to utilise the extra pasture production.

Table 3
Percentage of lambs drafted out at weaning*

Year	Weaning	All Sheep	Mixed Stocking
1964	July 15	73	88
1965	July 13	25	75
1966	July 5	8	43
1967	July 14	37	65
1968	July 18	25	80

*75 lb liveweight 1964, 1965, 1966, and 80 lb liveweight 1967, 1968.

Table 4
Cattle liveweight gains per head (lb)

	All Cattle			Mixed Stocking		
	Summer	Winter	Total	Summer	Winter	Total
1964/65	370	0	370	345	28	373
1965/66	364	120	484	410	62	472
1966/67	287	145	432	338	125	463
1967/68	371	101	472	416	108	524
1968/69	362	182	544	391	148	539

Table 5
Liveweight gain per acre

	Fat Lambs	Cattle	Mixed Stocking
1964	171	222	213
1965	533	484	476
1966	484	576	589
1967	627	691	705
1968	655	907	810

Table 6
Amount of Fertiliser applied per acre

	1964	1965	1966	1967	1968
Superphosphate, 8% P (cwts/acre)	4	3	3	4	4
Muriate of potash (cwts/acre) ...	1	1	1	2	2
Nitrogen, 23% N (cwts/acre) ...	3	3	3	4	6
Lime (tons)	4	—	—	—	—
Cobalt suplhate (lb)	2	—	—	—	—

Over the years there has been very little change in the phosphate and potash applications, but as stocking rate has increased, the nitrogen application has also been increased.

Nitrogen is applied both to the grazing area and the silage areas, and approximately 50 per cent of the total nitrogen is used for silage. On the grazing area nitrogen was applied in February to all paddocks and to some paddocks in May, June, July and August.

The most consistent result from this experiment has been the better performance of the lambs on the mixed system. The performance of the cattle on this system during the grazing season was not depressed and as compared with the all cattle system it was better most years.

The higher lamb growth rates on the mixed stocking treatment as compared to the all sheep treatment could be due to a number of reasons of which the most obvious are:

1. more pasture available,
2. less parasites, and
3. combinations of 1. and 2.

Since the cattle liveweight gains were not depressed on the mixed grazing treatment and since sheep graze more closely than cattle it is quite probably that there was no shortage of herbage on treatment C. On the other hand the all sheep pastures are always grazed very closely in April and it is quite possible that intake of feed by the ewe may be restircted which would reduce milk yield, and consequently, lamb growth rate.

Since the cattle were not young they would be resistant to intestinal parasites and consequently they would not be contaminating the pasture. This could result in a lower parasite burden on the mixed stocking treatment as compared with the all sheep treatment.

The individual performance of the cattle has been improving each year particularly over the winter period. This can be attributed to getting the conservation programme properly organised and as a result making better quality silage. For example in 1965 the land was closed for silage on May 15 and cut June 29; in 1966 it was closed on May 10 and cut June 29; in 1967 it was closed May 5 and the first cut was taken on June 17 and the second cut taken in August. In 1968 it was closed April 12 and cut June 1 and the second cut taken in July. The work by Dr. R. B. McCarrick at Grange has clearly demonstrated the advantages of early-cut silage in terms of performance of beef cattle.

Financial returns

In the sheep system a gross margin of £23 per acre was achieved in 1968. In the cattle system the gross margin was £41 per acre whereas in the mixed system it was £36. At first sight the returns from the sheep system are low but the following factors must be kept in mind:

1. Galway ewes were used in this project and the lambing percentage per 100 ewes mated was in the region of 115 percent. Evidence from work at Grange has shown that if cross-bred ewes (Greyfaces or Halfbreeds) were used the lambing percentage could be 135 percent and this would mean an extra £7-£8 per acre. This aspect is being studied at present.

2. Wool prices have been decreasing in recent years. The return per ewe from wool for 1968 was almost the same as that for 1964 even though wool yield had doubled.

3. The ewes on this project were lambed in mid-March and consequently they were fed meals before lambing. If lambing was put back until early April meal feeding could be reduced by allowing the ewes access to grass before lambing. We are now studying this approach.

4. Finally it should always be remembered that in order to set up a system of sheep farming less capital is required than for most other livestock systems and most of the capital is invested in livestock.

N.P. The returns from the cattle and mixed systems are quite good particularly when account is taken of the fact that the cattle came into the system at £11 per cwt. It should be noted that this work is being carried out on permanent pastures at high stocking rates and that average liveweight gain from April to March is almost 5 cwt. per animal.

One of the main problems encountered on this farm was the wintering of the sheep. Since the soils are liable to poach easily it was found that wintering ewes heavily concentrated on a paddock did not work as satisfactorily as at Grange. The paddock became so severely poached that ewes had no dry area on which to lie. For the past two winters the ewes have been wintered on a sawdust pad and this has worked quite well.

The results of this project again highlight the potential of Irish grassland, provided reasonable inputs of fertiliser are used and reasonable standards of management are practised. They also show that the return from drystock farming, while lower than that from dairying at the same level of intensity, are still very promising.

In conclusion, I would like to pay tribute to Aidan McLoughlin who as Farm Manager has been responsible for the success of this project at Ballintubber.

The Feeding and Management of the Suckler Herd

by

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PART I—SYSTEMS OF SUCKLED CALF PRODUCTION

Before considering systems of suckled calf production it is first of all necessary to examine briefly the feed requirements of the cow and calf.

As far as the feed requirements of the cow are concerned the year may be divided into two roughly equal periods one consisting of the latter stages of pregnancy and the first four months of lactation during which her nutritional requirements are relatively high and another period during which her nutritional requirements are for maintenance only apart from any need to restore body reserves depleted during the more productive period. In the case of the calf its requirement for feed independent of its dam is relatively small during the first two months of life but subsequently this increases rapidly so that by the time it is 4 months old the major part of its diet must be supplied directly to the calf (1) and if high levels of performance are to be obtained the quality of this diet needs to be high.

It should be obvious that systems of production designed to ensure that periods of maximum demand for feeds coincide as near as possible with periods when these feeds are most freely available are likely to be the most efficient. Again the year may be divided into two parts, the winter period when the diets available usually consist very largely of conserved feeds and the summer period during which the cow has to rely entirely upon grazing.

Winter diets can be divided into two major categories, those of relatively high quality, usually conserved grass products, and those of relatively low quality such as those based upon straw or other arable by-products. Similarly summer grazings fall into three major categories. Firstly, highly productive pastures on lowland and upland farms capable of responding to intensive systems of management; secondly the less productive pastures often found in the enclosed improved areas of hill farms, the major function of which might be to provide grazing for hill ewes at critical times, and thirdly the true extensive hill grazings.

All six possible combinations of winter diet and summer grazing are found in practice although some occur much more frequently than others and there are production systems appropriate to each. The major characteristic of any production system is the calving date and the choice of calving date is the most important decision associated with the management of a suckler herd. Various investigations (2, 3) have shown that when suckled calves are sold at the usual autumn sales the major factor affecting prices is calving date. However, improving sale prices by means of advancing the calving date does not necessarily increase profits but it must be recognised that in years when the autumn market is relatively weak it is the price of the younger and smaller calf which suffers most.

The combination of high quality winter diet and highly productive summer grazing is most frequently found on the all-grass lowland or upland farm. On many of these farms the bulk of the winter feed available will be in the form of good quality conserved grass. Where accommodation is not available to house weaned calves most of this conserved grass will be consumed by the cows. At the level of feeding which is required to satisfy the appetite of the cows this quality of diet will provide for much more than maintenance requirements. One way of exploiting this situation is to calve the cows in September and October so that at least the latter part of pregnancy coincides with a period of relatively cheap feed supplies. This choice of calving date has the further advantage that calving may take place outdoors in relatively good weather conditions so that many of the health risks associated with calving indoors under closely confined conditions can be avoided. Subsequently the cows and calves may be housed or outwintered according to circumstances. On lowland farms it may be necessary to house stock in order to avoid serious poaching of the pastures but on upland farms there are frequently areas of poorer quality ground with shelter which can be used to accommodate stock during the winter feeding period. The cost of housing for autumn calving herds is inevitably fairly high since space has to be provided for fairly large calves in addition to the cows towards the end of the winter. There is no doubt that the more recently introduced forms of housing utilising slatted floors or cubicles are the most suitable for the purpose since the cost of providing bedding for conventional housing is almost prohibitive.

During the early part of the winter the cows must receive the best of the available feed supplies but as soon as the cows are satisfactorily mated, say at the end of January, the emphasis can be changed to feeding the calves and the cows may be fed the poorer quality material available. Since the feed conversion of the rapidly growing calf is high, supplementary feeding with cereals can often be justified.

By the time the grazing season commences the feed requirements of the cows are relatively low but the requirements of the calves are high. If the summer pastures are to be utilised efficiently then some provision has to be made to prevent competition between cows and calves, either by weaning at the end of the winter or by practising some form of creep grazing system. In either case the calves can be allowed access to the best of the available grass and the cows function as scavengers. This system has a considerable advantage in that the output per cow can be very high (which may justify the relatively high cost of housing) and furthermore it has considerable flexibility in that the calves are sufficiently large to be marketed at any time after mid-summer.

An alternative system which is probably more applicable when weaned calves can be retained on the farm to consume the better quality winter feed, involves the choice of a spring calving date commencing say February. In this system the mating period coincides with the early part of the grazing season so that it is relatively easy to maintain a regular calving pattern. Furthermore, the milk yields of the cows respond to liberal supplies of spring grass and the progress of the calves can be quite spectacular with liveweight gains approaching 3 lb./day. Experience at the East of Scotland College of Agriculture (4) indicates that there is little difference in the profitability of the two systems except that the spring calving system is much more vulnerable to year to year fluctuations in the market when the calves cannot be overwintered. On the other hand it must be said that a considerable degree of skill and enthusiasm may be required to achieve high levels of output with the autumn calving system. Basically this is the system in combination with winter fattening which is practised at Henly Manor, the I.C.I. experimental farm (5).

In some areas, particularly in upland valleys, there exist on the same farm areas of highly productive grass in association with areas of poorer quality rough grazing or improved hill grazing. The major function of the more productive areas is to provide the bulk of the winter feed supplies and frequently it is the availability of these supplies which limits the stock carrying capacity on these farms. In addition, the more productive areas may have to be utilised for grazing purposes until the poorer quality grazing becomes available. These less productive areas often carry considerable sheep stocks throughout the season, or in the case of surface reseeded areas on hill grazings, are utilised for the hill flock during the lambing and tupping periods. In these situations the suckler herd, in addition to providing income from the sale of calves, fulfils an essential function in maintaining the poorer quality grazing, consuming, during the periods of more active growth, material which is surplus to the requirements of the sheep.

In these circumstances a system based upon autumn calving is not feasible because there is not sufficient good quality summer grazing available for the calves. Also, because of the considerable pressure on feed supplies during the early part of the grazing season, there is a considerable risk that calves will not be sufficiently well grown by the autumn sales when as many as possible must be sold off the farm. Furthermore, any clash between the calving period and lambing must be avoided, otherwise excessive demands upon labour can occur. Under these conditions, there is little alternative to advancing the calving date into January and February and accepting the fact that the cows will have to be fed very liberally at the end of the winter to ensure that cows are satisfactorily mated and their milk yields held at a level which will ensure a degree of protection for the calves when feed supplies are limited at the beginning of the grazing season. Inevitably these higher feed costs will affect the profitability of the suckler herd but most farmers would offset this against the benefits derived from the function of the suckler herd in maintaining the grazings for sheep.

The combination of high quality winter diets and very poor open hill grazings occurs most frequently where farms are situated in steep valleys in mountainous areas and also when separate farms in both extreme hill and lowland areas exist in the same ownership. Traditionally the extreme hill grazings have carried stocks of small hardy cows calving in late spring but as farmers on lowland fattening farms have placed more and more emphasis on the size and growth potential of the calves they buy it has become increasingly difficult to find a market for the small hill calf. At the same time it is still thought that there are considerable benefits to be derived from the presence of cattle on hill grazings. One method which is now being adopted is to employ a variant of the autumn calving system suggested for lowland farms, weaning the calves in the spring and grazing them at high stocking rates on the better quality grass while the dry cows spend the summer grazing period on the open hill. In this way it is possible to utilise a larger and more productive cow which, when freed of the necessity to produce milk, can still perform a useful function on the hill and at the same time produce a calf more suited to current market requirements. Clearly this is a system which can be very attractive to the farmer who has both hill and lowland units but where the area of good quality grassland is limited the effect of using some of this for the grazing of weaned calves must be to reduce the winter feed supplies and the number of cows kept unless purchased feed can be used to replace that lost by grazing some of the acres previously used for conservation.

Winter diets of low quality are often based upon arable by-products such as straw and are encountered most frequently in combination with highly productive rotational grassland on arable farms where a major part of the income is derived from cash crops. During recent years, despite a growing tendency towards continuous cash cropping, many farmers have expressed a wish to re-introduce grass into their rotations as a break crop so as to avoid some of the problems associated with continuous grain growing. The major problem has been to devise some means of extracting sufficient income from these acres in order to provide a satisfactory alternative to cash cropping. In this connection some recent work at the North of Scotland College of Agriculture is relevant and will be described in some detail in part II since it illustrates not only a system of production suitable for this particular set of circumstances but also many of the problems which have to be faced in devising any production system.

Furthermore, it is on this type of farm that the major opportunity for the expansion of the production of beef animals exists. Most of the suitable animals produced by the dairy industry are now being utilised and any further increase in the supplies from hill and upland areas is likely to be slow and costly.

On many hill farms the area of enclosed rough and improved hill grazing is often capable of carrying a much greater number of cows during the grazing season than can be supported by the limited number of acres available for the production of conserved feed. To overcome this problem additional feed is purchased and frequently much of this is in the form of straw or hay of doubtful quality and much of the home produced feed may consist of arable silage or green oat hay because of the necessity to produce the maximum bulk of feed from a limited area. These feeds provide a basis for a winter diet similar in quality to that used in the North of Scotland College of Agriculture experiments. However, because of the necessity for an early calving commencing in January on these farms the level of supplementation has to be raised considerably in the latter part of the winter or at least good quality hay substituted for the poorer quality roughage.

The worst combination of poor quality winter feed supplies and open hill grazings occurs quite frequently in the more remote mountainous areas in the north and west of the British Isles. In these areas it is not possible to augment winter feed supplies with bulky purchased feeds because of heavy transport costs and purchases have to be restricted to minimum quantities of concentrated supplements. Inevitably calving has to be delayed until late spring under these conditions and because of the poor quality of the summer grazing only the smaller type of hardy hill cow can maintain herself and suckle a calf adequately. Consequently many of the calves produced under these conditions are small and difficult to market. It is doubtful whether there is much future for this form of production. A modification of the grazing conditions by means of surface treatment would make it possible to maintain a larger cow or at least enable the cow to suckle a calf sired by a bull of one of the larger breeds. In the past it was the practice to mate many of the cows of the hardy hill breeds to bulls of a larger dual purpose type such as the Cumberland Shorthorn so that although calves might have been small when weaned they had a considerable potential for growth and the females met a ready demand as replacements for suckler herds elsewhere. In recent years since the virtual disappearance of the large dual purpose type of Shorthorn, sires of the early maturing beef breeds have been used instead and although many of the calves are of attractive conformation, their small size and lack of growth potential makes them difficult to sell to buyers from lowland fattening farms and the unpredictable maternal qualities of the females considerably reduces their value as potential herd replacements. To suggest that the Friesian which has largely replaced the dual purpose Shorthorn in its dairy role might also replace it as a crossing sire will no doubt be regarded as heresy by many but it certainly has the potential to remedy the major defects which currently exist in these calves. If these changes were accompanied by some arrangement to grow the calves on better farms until they reached a more marketable size then the future of suckled calf production in these difficult areas would be more certain. Fortunately this latter arrangement has already a small beginning on a co-operative basis in the North of Scotland.

There is clearly a very wide range of circumstances in which suckled calf production is practised and a considerable number of ways in which these systems can be varied.

PART II—SUCKLER COWS ON ARABLE FARMS

The major objection to beef cows on lowland arable farms is that under conventional systems of feeding and management the acreage requirement/cow is high and therefore profit/acre is low.

It was, therefore, decided to explore the possibility of reducing this acreage requirement. One way of doing this is to devise a winter feeding system based upon barley straw which makes no demand upon farm acres and restricts the acreage requirement to that necessary for summer grazing.

At the level of nutrition required to provide for maintenance or low levels of milk production straw is potentially a valuable feed. However, a diet of straw alone is likely to be inadequate in terms of energy, protein, minerals and vitamins. The two latter components can be readily supplied as a mineral/vitamin mix. The conventional way of supplying the protein supplement would be to use a vegetable protein source such as Ground Nut Cake. A second source, currently attracting a considerable amount of attention, is urea which supplies nitrogen in a non-protein form. Draff (Wet Distillers' Grains) is a further possibility either fed alone or in conjunction with barley.

The Establishment Year November, 1965—31st October, 1966.

Since relatively low levels of nutrition were to be expected from the diets employed it was decided to delay the commencement of calving until February to avoid the need for heavy supplementary feeding to maintain milk production during a long winter feeding period. Hereford x Friesian females were chosen for their obvious maternal qualities which it was hoped would compensate for the delayed calving. 40 of these were assembled during November and December 1965, mostly heifers in calf.

During the winter 1965/66 it was decided to feed four groups of 10 animals each on 4 diets consisting of barley straw *ad lib.* with supplements.

A. 25 lb. draff to supply 1.2 lb. Digestible Crude Protein, 3.5 lb Starch Equivalent.

B. $12\frac{1}{2}$ lb. draff + $2\frac{1}{2}$ lb. barley to supply 0.8 lb. Digestible Crude Protein, 3.5 lb. Starch Equivalent.

C. 5 lb. barley + 70 gm. urea to supply 0.8 lb. Digestible Crude Protein, 3.5 lb. Starch Equivalent.

D. 5 lb. of a mixture of 3 barley: 1 Ground nut cake to supply 0.8 lb. Digestible Crude Protein, 3.5 lb. Starch Equivalent.

All cows received daily $\frac{1}{3}$ lb. of the following mineral/vitamin mix:

36 lb. Steamed Bone Flour; 11 lb. Calcined Magnesite; 1 lb. Manganese Sulphate; 8 lb. Salt; 1 oz. (30 gms.) Copper Sulphate; 1/5th oz. (6 gms) Cobalt Sulphate; 200,000 I.U. per lb. Vitamin A; 20,000 I.U. per lb. Vitamin D.

Supplement A contains what is considered to be sufficient D.C.P. to meet all the requirements of the pregnant cow.

Supplements B, C and D contain only $\frac{2}{3}$ of this optimum level and expect the aminal to meet additional requirments either from the barley straw or from body reserves. This is a level which is commonly found in farm practice with other diets and also approximates to that employed by other workers studying the use of non-protein nitrogen supplements. All four supplements have been designed to supply the same amount of Starch Equivalent (S.E.) (within the limits of our existing knowledge). On the evidence of the relatively small weight losses incurred by these heifers and the performance of their calves, it was decided that additional supplementary feeding was not required and the original levels of supplementary feeding were maintained throughout the whole period until the animals were turned out to graze on 2nd May. The differences between the average bodyweight changes after calving were small and appeared to be associated with the differences in average straw consumption. Average daily consumption of barley straw was for:

Group A: 12 lb.

Group B: 14 lb.

Group C: 17 lb.

Group D: 17 lb.

During the summer period the 40 heifers, their calves, 4 bulling heifers and a bull were maintained on 27 acres of permanent grass divided into 8 paddocks. In order to do this the heifers were allowed to consume grass to appetite during the early part of the season and as the season progressed, the calves were allowed to creep graze so as to avoid competition between the heifers and calves as grass production declined. During the early part of the season the heifers gained a considerable amount of weight and even during August and September maintained their bodyweight.

Two cases of muscular dystrophy occurred during the first week of the grazing season. There was no evidence that these were due to any particular supplement fed to the heifers during the winter. However, there is a considerable amount of evidence to show that this condition is frequently associated with other diets based upon low quality roughage and it was decided that in the future calves would receive supplementary vitamin E and/or selenium during the latter part of the winter.

The fertility of the heifers was satisfactory. A Hereford bull ran with the herd during May and June and all heifers except four which calved late were successfully mated during this period.

First Full Year 1st November, 1966-31st October, 1967.

There was no apparent difference in performance between the groups of heifers receiving the four different supplements during the 1965/66 winter. However, it was clear that animals consumed less straw when receiving draff. In some areas, draff is more readily available and cheaper than straw. It therefore seemed desirable to determine the effect of feeding draff to appetite on both straw consumption and animal performance and so group D were fed draff to appetite during the 1966/67 winter.

During this period, the cows were fed the following supplements and consumed the amounts of straw indicated.

Group A. 25 lb. Draff + $14\frac{1}{2}$ lb. Straw.
Group B. $12\frac{1}{2}$ lb. Draff + $2\frac{1}{2}$ lb. Barley + 17 lb. Straw.
Group C. 5 lb. Barley + 70 gm. urea + 23 lb. Straw.
Group D. Draff to appetite (40 lb.) + $11\frac{1}{2}$ lb. Straw.
(Minerals and Vitamins to all groups).

The herd was housed from 1st November, 1966 to 25th April, 1967. Calving commenced 6th February, 1967. The mean calving date was 6th March. During the 1967 summer the total herd comprised 48 cows and 50 calves which were maintained on 33 acres of grass. Nitrogen usage was 160 units N/acre. Supplementary feed was introduced to the calves on 12th September, 1967 and the calves were weaned gradually at the end of September.

At the beginning of the 1966/67 winter the mineral and vitamin supplement was amended to include trace levels of copper and cobalt and all calves were dosed with selenium as a means of preventing muscular dystrophy.

A Lincoln Red bull was run with the herd from turnout to mid-July. *Second Full Year* 1st November, 1967-31st October, 1968.

During the winter of 1967/'68 Groups A, B and C were maintained on the same basic treatments as before but Group D was transferred to the barley/urea treatment in order to obtain more information about this treatment. In addition, the quantities of the supplemens were raised by 20 per cent, partly to cater for the increase in the size of the cows during the previous year. The daily supplement of the four groups together with the approximate quantities of straw consumed were as follows:

Group A 30 lb. Draff + 16¼ lb. Straw.

Group B. 15 lb. Draff + 3 lb. Barley + 18¼ lb. Straw.

Groups C. & D. 6 lb. Barley + 70 gm. urea + 26 lb. Streaw.

The herd was housed from 8th November, 1967 to 24th April, 1968. Calving commenced 12th February, 1968. The mean calving date was 13th March.

Again during the 1968 summer the cows and calves were stocked at 3 cows/2 acres and paddock grazed. Nitrogen usage was 160 units N/acre. The calves were weaned at the end of September and the cows are again in calf to the Lincoln Red bull.

Physical Results from Years 1966/67 and 1967/68

Table 1 shows the average weight losses by the four groups of cows during the two winters. During the 1966/67 winter Group D clearly differed from the other three groups in that its weight loss was negligible. However, these figures do not tell the whole story since Group C was obviously in poorer condition than the other groups as many who saw the cows at the demonstration will remember.

Table 1

Winter Weight Losses of Cows lb.				
Group	A	B	C	D
1966/67	81	69	86	3
1967/68	71	107	138	264

During the 1967/68 winter there was again little difference in the losses of Groups A and B. The loss of Group C was a little higher and Group D which had retained its weight advantage during the 1967 summer lost it during the following winter.

Table 2 shows the birthweights of the calves in the two years and for Groups A and B indicates little difference between either the treatments or the levels applied in the two years. The results for Group C, however, seem to indicate that at the level applied 1966/67 the Barley/urea supplement seemed to depress birthweights in a year when straw quality was poor. The superior birthweights of Group D are probably a characteristic of this Group since they have been achieved on both extremes of diet.

Table 2

Birthweights of Calves lb

Group	A	B	C	D
1967	76.8	77.5	72.7	84.2
1968	78.2	78.0	80.2	83.0

The gain of calves from birth to turnout gives a further indication of the effect of the winter diets. The data in Table 3 tend to follow the same pattern as the birthweight data and furthermore indicate that the levels of supplementation were more satisfactory in 1967/68.

Table 3

Gain of Calves (lb/day) Birth-Turnout

Group	A	B	C	D
1967	1.44	1.54	1.03	1.79
1968	1.83	1.98	1.63	1.82

Clearly the final assessment of the winter treatment must be based upon the performance to weaning of the calves. Table 4 shows the weaning weights for the two years.

Table 4
Weaning/housing weights of calves (lb)

Group	A	B	C	D
1967	502	504	479	504
1968	532	556	532	534

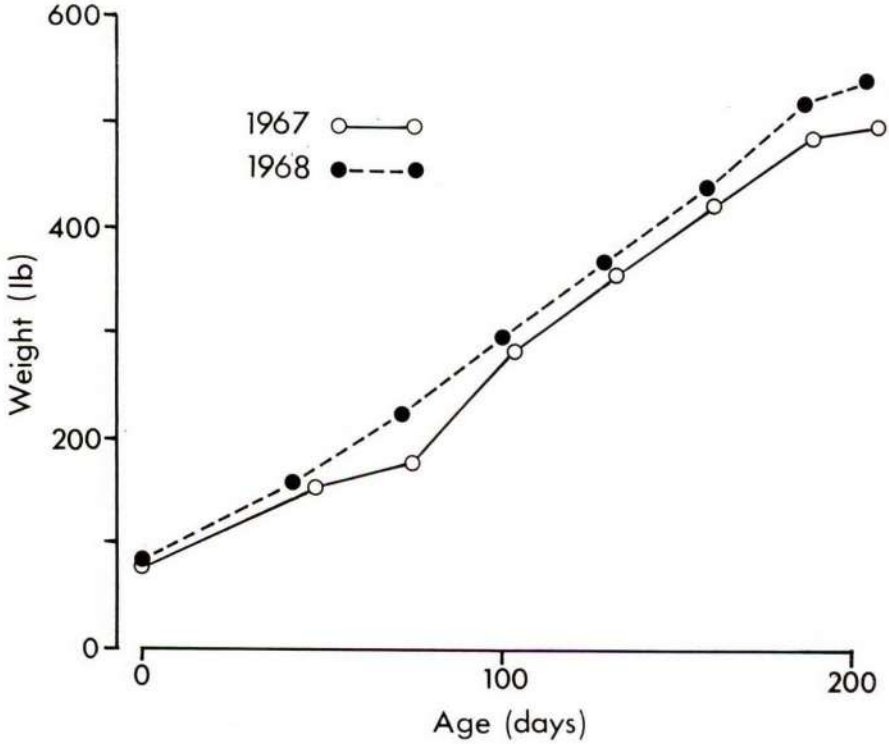
Table 5 shows the average daily gain of the calves from Birth to Weaning.

Table 5
Daily gain of calves (lb) Birth-weaning

Group	A	B	C	D
1967	2.02	2.08	1.99	2.06
1968	2.17	2.29	2.30	2.26

These data would seem to indicate that there is little to choose between the winter diets employed in these studies particularly at the level employed in 1967/68. At the levels employed in 1966/67 when straw quality was poor the Barley/urea supplement may have been slightly inferior. However, one could not recommend this level of supplementation in practice since there would seem to be a risk of impairing the fertility of the cows. It is doubtful whether the improved performance of the calves to weaning in 1968 can be attributed to the improved level of supplementation in 1967/68. (See performance of Group D). It is more likely that it is partly due to the increased age of the cows and partly due to the change of sire. The diagram showing the progress of the calves from birth to weaning in the two years shows that the superiority of the 1968 calves increases with age indicating that the Lincoln Red sire may be largely responsible for the improvement.

Overall it can be stated that the technical problems encountered in developing this system have been fewer than might have been expected. There still remains some work to be done to improve the Barley/urea supplement but even at this stage of development it is quite acceptable. Furthermore it has been appreciated from the outset that a modification of the system to carry the calves through to slaughter could make



the summer management much easier in addition to stabilizing returns through selling on a guaranteed market.

Financial Returns

Clearly when an attempt is made to develop a system of production such as this it is necessary to apply some sort of financial appraisal to the physical data. Two questions need to be answered.

1. Is the system capable of yielding a satisfactory return per acre?
2. Is the system likely to provide a satisfactory return on the capital involved?

In these circumstances it is possible to apply a form of gross margin analysis. The average gross margin for the two full years described is £48 per acre and the estimated return on tenants capital is 15 per cent.

It must be emphasised that this form of financial appraisal must be treated with extreme caution. It can only give an indication of the potential of the system. However, these returns indicate that the system merits serious consideration, particularly by grain growing farmers who would like to increase their grass acreage.

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Multiple Suckling of Calves

by

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Introduction

I wish to describe a multiple suckling system of calf rearing which we have developed at Grange. This system was derived from our earlier work on calf rearing and particular attention was given to the possiblity of using first quality grassland. It seems obvious also that a cow of high biological efficiency should be used. The system involved suckling six calves per cow and even at this stage I would ask you to bear in mind that in any calf suckling system the cow is the big eater in the acre or whatever unit of land is chosen.

M. Drennan gives you details of his single suckling work at Grange in his paper on page 29.

It is important also to stress at this stage that:

1. Barley prices (and therefore concentrate prices) have risen very considerably—by about one third over the last eight years.
2. Milk replacer prices have increased by over 20 per cent since the ruling by the Minister for Agriculture that butter fat is the only sourc of fat to be used in milk replacers.
3. Whole milk prices are now either remaining static or decreasing. Taking into account that the cost of living continues to rise then it is reasonable to say that milk, particularly if it is produced in any sizeable quantity, is going down in price.
4. Finally, there is the Government subsidy towards encouraging beef production. You will appreciate therefore that while a suckling system may not have been economical a few years ago many factors have now changed, which look like making this system of beef production most interesting.

Background

Before setting out the system I will refer briefly to some background work we have done on effects of intervals of feeding on calf performance. I will also give figures on performance of calves suckled at different numbers per cow. Many of you will recall that I presented this work in detail to you some years ago (1).

We showed at Grange, like others, that calves could be reared successfully by feeding once daily, either through buckets or through a calfeteria. You can see from Table 1 that there was no major difference in calf liveweights at $1\frac{1}{2}$, 3 or 6 months of age.

Table 1
Performance of calves fed their milk once or twice daily

	Liveweight (lb) at:			
Milk feeding	5	42	84	168 days
Twice daily 5–84 days	87	122	197	323
Once daily 5–84 days	93	120	195	304
Once daily 12–84 days	94	130	205	330

I should perhaps emphasize that the level of milk feeding in the experiment described in Table 1 was low and I feel this is important. All calves received 1 gallon of milk replacer (one gallon = 1 lb. dry powder + 9 lb. water) per head per day and meals were available *ad lib*.

In fact, we found that when we ommitted Sunday feeding to some of the treatment groups the performance of these calves was no different to that of calves fed every day of the week (1).

Table 2 shows the performance of multiple suckled calves at pasture at different numbers per cow and over four grazing seasons. All these calves were born in mid-March and went outdoors almost immediately.

Table 2
Performance of calves suckled at 3, 4 or 6 per cow

Treatment	Liveweight (lb) at (weeks)				Milk intake (galls)
	4	18	25	32	2–18 weeks
3 calves/cow (1965) ...	106	278	349	—	131
4 calves/cow (1966) ...	101	254	322	373	104
6 calves/cow (1967) ...	112	293	375	436	104
6 calves/cow (1968) ...	111	283	356	403	89

In 1965 and 1966 the cows were grazed separately from the calves but in 1967 and 1968 the cows and calves were rotationally grazed. The cows were following the calves in rotation. The stocking rate in 1968 was higher than in 1967. Table 2 shows that the performance per calf in 1967 and 1968 was superior to that of those reared in earlier years. This is particularly noticable when 1965 and 1967 or 1968 is compared, since the intake of milk per calf in 1965 (131 gallons) was greater than in 1967 and particularly so than in 1968. It appears from these experiments that grass quality is very important because in the years (1965 and 1966) in which we had good control over grassland management and had good grass available throughout the grazing season, we had the heaviest calves at 32 weeks of age. We had considerable difficulty in maintaining good grass quality for calves in 1965 and 1966 but this problem did not arise in 1967 because of the presence of the cows in the system. In 1968 and 1969 there was also no problem in maintaining good grass quality.

The system

Armed with the above data and of course other facets of calf production that is encountered over the years in research and production we set out the following multiple suckling system. In it we have 8 cows suckling 48 calves (i.e. 6 calves per cow). The calves (mainly Hereford x Shorthorns and some Hereford x Friesians) were born in mid-March and suckled the cows throughout the grazing season in a controlled system of management. Suckling and grazing finished in the first week of November. We give each cow and six calves 2½ acres (a total of 20 acres in the system) to provide grazing and silage for the 8 cows and 48 calves, i.e. 56 animals (Diagram 1).

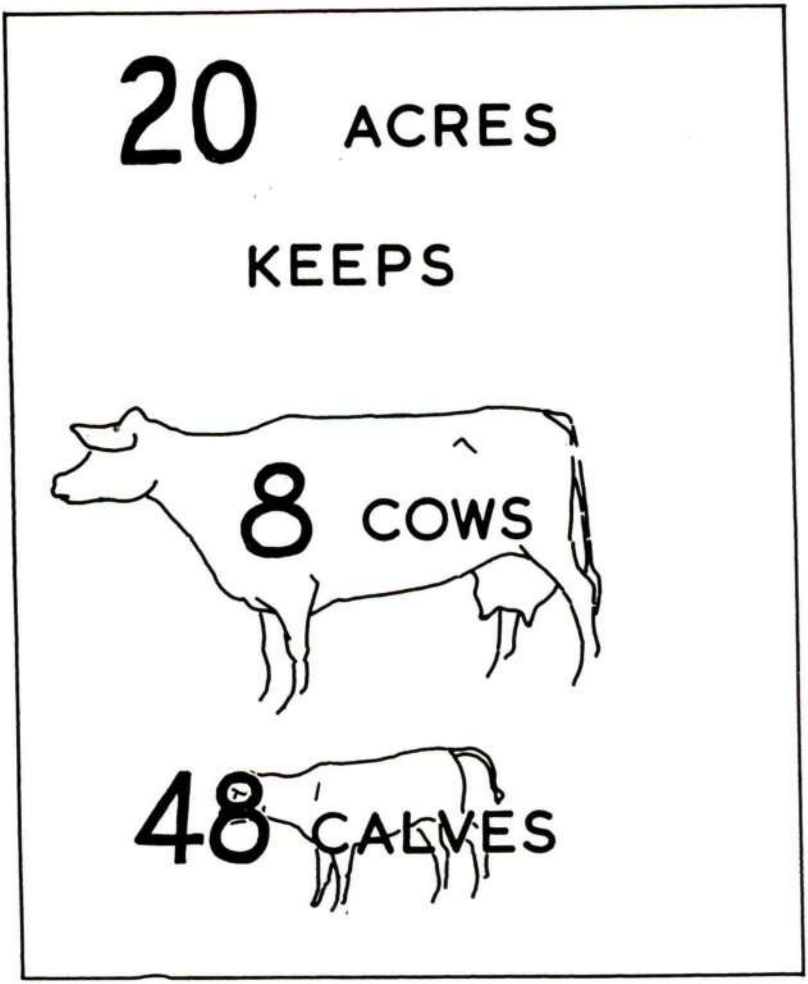
There is a small pen in each grazing paddock for suckling (Diagram 2). The cows are put into this each morning about 8.30 and 32 of the 48 calves are allowed to suckle the cows. In the afternoon the cows are put into the pen again (about 4.30) and the remaining 16 calves are suckled. Each group of calves is therefore suckling *once* daily. The "morning" and the "evening" calves are kept separately to facilitate the suckling management.

In an experiment now going on at Grange we are using a suckling race instead of the pen and it is certainly a much more convenient method of suckling. It allows the cows to move about a lot less and also allows greater ease of introducing calves on to cows in the first two weeks or so. In wet weather it also has some attractions over the pen idea, in that cows do not have access to the same area as the calves and so the ground does not cut up so easily. Obviously care must be taken to have the lower bar of the race the correct height. We are at present looking into the possibility of designing a suitable mobile suckling race. All calves go before the cows in a rotational paddock system. We have not fully worked out yet the right number of paddocks to use but you will understand that 2 paddocks are always occupied. Some interesting work being done at present by Dan Browne may help to elucidate this problem.

Grazing and silage

The 8 cows and 48 calves only require 9 of the 20 acres for grazing to the second week of May. Diagram 3 shows the proportions of the 20 acres used for grazing and silage at various stages throughout the grazing season. A further 3 acres is added at that stage and it is only from the end of August that the whole 20 acres is grazed.

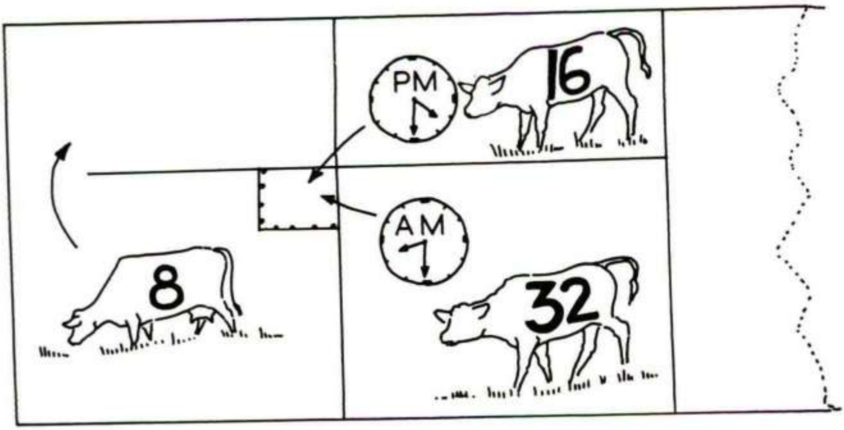
We, therefore, cut silage 3 times off 8 acres and once off 3 acres. This gives us a total yield of silage of approximately 200 tons. This



provides us with more than sufficient silage for the 8 cows (5 tons each) and 48 calves ($3\frac{1}{2}$ tons each).

It is obvious we are getting over one of the big problems in outdoor calf rearing which is grass control and it is almost impossible to maintain good grass growth. This has also been shown at Hurley (2) and at Moorepark (3).

It will also be appreciated that calves grow in the opposite direction to grass. When the calves have grown big, by say July, grass growth is easing off. My colleague working on the physiology of grass growth at Grange says that about 60 per cent of the seasons' grass is grown by mid-July in normal years (4).



Parasite control

We are now finishing our second year on the same 20 acres of land and we have encountered to date no major disease problems. The calves are dosed mid-June and again about six weeks later. Husk has not been a problem, though some was present. This is being checked out by our parasitologist, Dr. Downey.

The cows were kept in outdoor cubicles last winter and this winter we hope to keep the calves also in 'topless' cubicles. This follows my colleague Dr. McCarrick's work at Grange on wintering where he found no difference in cattle performance whether they were outdoor or indoors, when given similar amounts of feed (5).

Animal performances: Table 3 shown the mean growth rates and milk intake of the calves for various periods throughout the grazing season.

AREAS ALLOTTED TO GRAZING & CONSERVATION

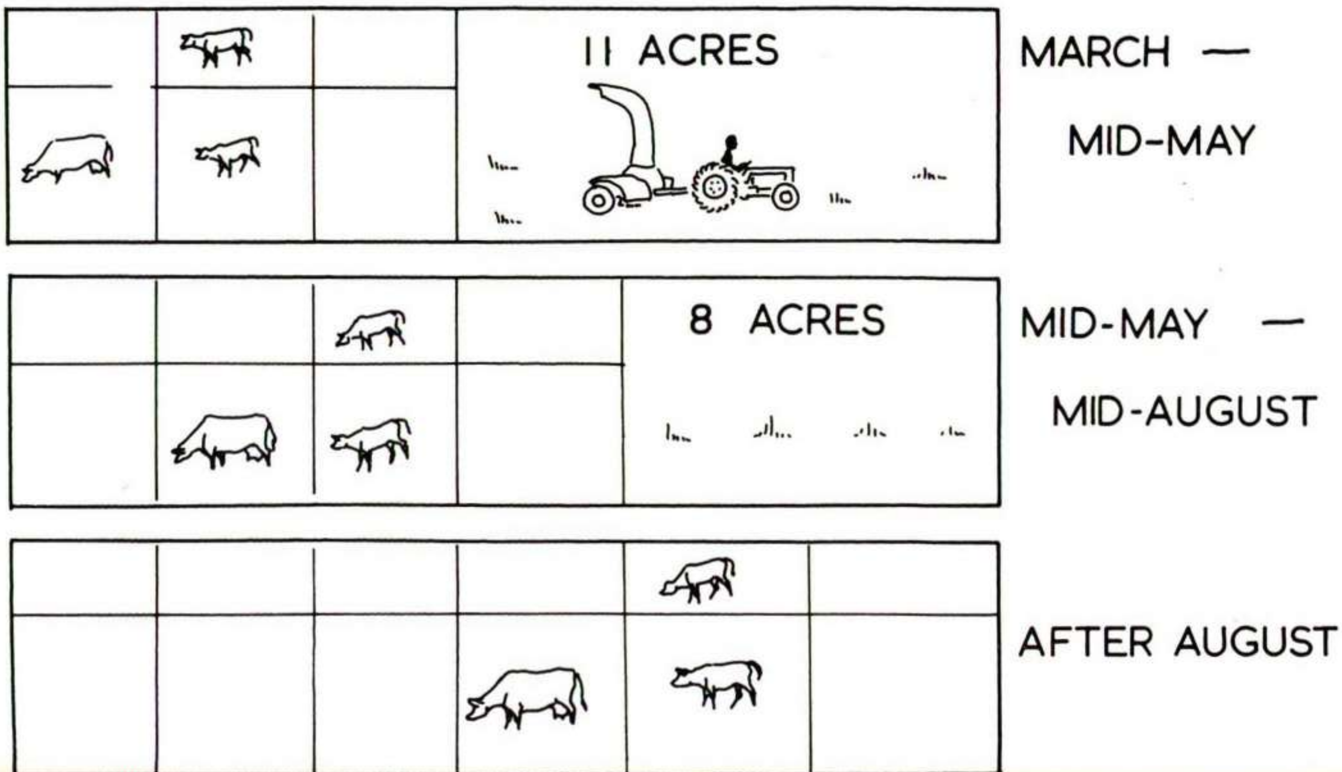


Table 3.
Mean liveweight gains and daily intakes of suckled calves

	Total gain (lb)		Daily milk intake (Galls)	
Period	1967	1968	1967	1968
14–28 days	11	17	—	—
29–42 days	19	16	.86	.72
43-98 days	106	105	.91	.77
99–224 days	199	171	.65	.60

The mean daily milk intakes of the calves never reached a gallon a day. Milk intakes are recorded by weighing the calf before and after suckling the cow. It was not convenient to do this before 14 days of age. We know, however, that the yield per cow was lower in the period before 29 days than thereafter. While low intake is undoubtedly lowering performance in early life it *may* have the advantage that you have less scouring troubles.

We looked at the performance of individual calves and related gains to milk intakes. We found that those calves that had the highest intakes (were consistent in having them) were the biggest calves on the experiment and also had the highest gains. This was true from the various periods throughout the experiment. However, taking any group of calves within a particular weight range it did not follow the calves with the highest milk intake also had the highest gains (Table 4).

Table 4
Mean milk intakes and liveweight gains (lb) of suckled calves

Age (weeks)			
2–18 weeks	Wt. gain	235 (2.1)*	170 (1.5)*
	lb milk/lb gain	4.5	4.6
2–8 weeks	Wt. gain	55 (1.3)	29 (.7)
	lb milk/lb gain	7.6	10.6
9–18 weeks	Wt. gain	179 (2.6)	141 (2.0)
	lb milk/lb gain	3.6	3.4

*Average daily gain (lb).

The mean weight of the heavy and light calves at 2 weeks was 110 and 90 lb., respectively and the average daily gain of the remaining calves in the group was 1.8 lb./day from 2-18 weeks of age. In general the calves were fairly heavy but this type of calf is readily available on the market in Spring.

Milk yields
The average milk yields of the cows was 768 gallons for 1968 and the mean milk intakes of each calf was 128 gallons. The mean liveweight of the cows at the start of lactation was 518 kg. and it was 539 kg. at November. Work at our dairy research centre at Moorepark and in New Zealand shows that you may expect an increase in milk yield due to suckling out rather than milking out twice daily. Dr. John Walsh is in charge of the work at Moorepark and he has some interesting work done and in progress on how a multiple suckling system will fit into the rearing of dairy herd replacements where there is a spread on calving.

These multiple suckled calves can be got to 6 cwt. at one year old having been wintered on good silage (and the grassland management in this system almost ensured good quality silage) plus 3-6 lb. barley/head per day (representing a daily L.W.G. of 1.75 lb. during the winter period). The liveweight targets for various ages are set out in Table 5. Incidently, it is likely that these targets could be much higher if we had used a calf of greater growth potential.

Table 5
Livestock (kg) of multiple suckled calves at various stages up to one year old

	Kg.	Lb	A.D.G. (lb)
Wt. at one month	51	111 ...	1.0
Wt. at three months	93	204	1.75
Wt. at 8 months	205	450	1.70
Wt. at twelve months	306	672	1.75

It will of course, be appreciated that it is much easier to get an Autumn born calf to 6 cwt. at 1 year than it is to get a Spring born calf to 6 cwt. when it is 1 year old due to its ability to use grass in its first grazing season. It is obvious therefore that the earlier your calf is born in the Spring the greater will be his weight at one year old.

Production per acre
We can now estimate total production per unit of 1 cow and six calves on $2\frac{1}{2}$ acres and then work out production per acre. From $2\frac{1}{2}$ acres you can expect a liveweight gain of 30-31 cwt. (or a total liveweight of animals, other than cows at the end of one year, of 36 cwt.). This means a liveweight gain of at least 12 cwt. per acre, and the acre is also producing 2/5 of a calf and feeding 2/5 of a cow. To achieve this

production per acre you will also need approximately 10 cwts. of barley (equivalent to approximately a further half acre at most) plus fertiliser. Leaving these male calves entire will further enhance production. This has been proved by extensive work at Grange on bull beef production (6, 7, 8). Changing the breed of animals and particularly earlier calving would also increase production per acre.

Fertiliser requirements
The mean fertiliser input per acre (over the 20 acres) at Grange is given in Table 6. I will not dwell on the amount of fertiliser we used as this will obviously vary with soil type and climate.

Table 6
Mean fertiliser inputs per acre (on the 20 acres)

Fertiliser	Units	Cwt.	% active ingredient
Nitrogen	100	4.3	23
Phosphate	48	3.0	16
Potash	200	4.0	50

Indeed it may well be that this amount of fertiliser is too high. We have a considerable amount of work in progress at Grange and at other centres of the Institute at present to determine the "maintenance" requirements of different grassland under intensive farming systems.

Economic returns
It is now possible to draw up a rough balance sheet for the year and this is given in Table 7. Incidently it will be appreciated that if we ignore the barley input as a purchase then each unit of one cow and six calves will require approximately 3 instead of $2\frac{1}{2}$ acres.

Table 7

Expenditure and returns (£) per unit and per acre

	Variable Costs			Gross Output	
	Per 2½ acres	Per acre		Per 2½ acres	Per acre
Calves 6 @ £27	162	65	6 calves @ £66 each	396	158
Fertiliser costs £10 per acre	25	10		Gross Margin	
Silage making 25 tons @ 12/-	15	6		£51 per acre	
Barley=30 cwts @ £1/10 per cwt.	45	18			
Medicines etc. £1/10 per calf	9	4			
Cow depreciation	10	4			
		107			

This is a very approximate balance sheet and the gross margin can obviously be swayed either way depending on pricing of inputs and outputs. I think the costings I have given are reasonably conservative. Each individual can apply his own pricing depending on his farming system. It will be appreciated that a purchase charge of 6 calves at £27 each is high as it almost assumes a mortality of 1 in 6. In fact we have had no mortality using 48 calves in each of the two years. Allowing for a purchase of 5 calves (the cow's calf will make up the sixth but it has an equal chance of being a heifer) the expenditure per acre in calves would be reduced from £65 to £55. This would have a result of increasing the gross margin by £10 per acre. Using Friesian calves (because they are usually cheaper at purchase rather than beef crosses) will also likely increase the gross margin further.

Tables 8 and 9 clearly show the effect of calf prices and beef prices on margins per acre. It is obvious that if calf prices are not too high gross margins will be very good. If calf prices are very high (over £30) the systems which will produce the calves on the farm, i.e. single suckling and heifer beef both become attractive.

Table 8

Effect of variable beef prices on gross margin per acre (£)

Price per cwt	Return per acre
7	36
9	65
10	79
11	94
12	108
14	137

Assuming a purchase price of a dropped calf of £27 and selling at 6 cwts.

Table 9

Effect of variable calf prices on gross margin per acre (£)

Calf prices	Return per acre
35	32
30	44
25	56
20	68
15	80

Assuming a price of £11/cwt. for cattle 6 cwt. @ 12/13 months.

Labour is also not included. Allowing that a man could manage 60 acres in this system (with help at peak periods) then the cost of permanent labour per acre would be about £17 per acre (£1000/60)

The Government subsidy for beef is not included but of course in a multiple suckling system this will only have a small impact, particularly, when the subsidy is per cow and not per calf. In fact the impact per acre is smaller when the number of calves per cow is high, yet it is well to remember that the cow is the "big eater" in the acre and as soon as you reduce calf numbers per cow you reduce performance per acre. The investment per acre is about £100 (allowing the cow is worth £80) and therefore is higher in stock and lower in equipment than in dairying).

Conway (9) gave the members of this Association, last December, details of a beef production system at Ballintubber and you will see the targets he set for these type of cattle at two years old.

Multiple suckling v. Dairying

It is now perhaps interesting to contrast this system of multiple suckling with milk production at the present time using 60 acres in both instances. An intensive cow unit will be stocked at approximately one cow to the acre.

During the summer period there is only 24 cows to be milked in the suckling unit as against 60 in the dairy unit. At least 16 cows can be milked simultaneously which is a very "large milking plant". There is also no walking of cows to and from milking units, washing milk plant, milk transport, etc. Sixty cows will have to be wintered in the dairy unit as against 24 cows and 144 calves in the suckling unit.

The labour requirements in the suckling unit will be lower in the summer than in the milking unit. The reverse is true in the winter. This might not be to the disadvantage of the suckling unit since most systems of livestock production need extra labour in the summer for silage making.

The economic returns from the two systems are not greatly different. If calf prices are low this will be to the advantage of the multiple suckling system and the disadvantage of the dairying system. The reverse is also true. If all the subsidies were ignored then it is likely that the miltiple suckling system is a more economically efficient system per acre than the milking system.

A few general points are worth mentioning:

1. From the work at Grange it appears that many of the calves for this system could come from beef type heifers.
2. We feel all calves should be foster calves, though some of the work being done by Dr. John Walsh suggests that this may not be important.
3. It is necessary to have a bull as it is usually not possible to see the cows in heat and therefore you do not know when to call A.I.
4. Like all intensive grassland units good fencing is essential.
5. Compared with some other systems of calf rearing, for example group rearing on milk replacer to 8 weeks outdoor, followed by grass and meals, the multiple suckling system will require:
   (a) More labour—though considerably less than if you milk the cows as in dairying. ...

(b) More acres—20 acres will keep 8 cows and 48 calves for one year while an intensive calf unit of 20 acres will keep approximately 100 calves to one year old.

(c) More capital, but less capital/acre than an intensive calf system.

(d) Less mortality and veterinary expenses.

(e) Allows a greater flexibility in selling.

(f) Less wintering facilities but somewhat more silage capacity needed.

There are many interesting research problems presented in this work. Parasite control and grass utilisation need further elucidation. It will of course also be particularly interesting to see what will be the effects of (i) earlier calving (ii) faster growing animals (breeds) and (iii) using bulls instead of steers.

Summary

It will be appreciated that the basic principles of our suckling system are described here (indeed the basic principles of good calf rearing are also included). Of course, there are many variations that could be adopted. Some farmers may (i) not wish to rear calves outdoors (ii) not wish to suckle six calves per cow and (iii) wish to suckle calves for much shorter periods than that described here and thereby rear considerably greater numbers of calves per cow or return the cows to the milking herd.

In particular many farmers could consider combining some of the earlier work on early weaning (10, 11) with suckling, that is, in effect giving small amounts of whole milk per calf yet instilling into early weaning the "health factor" of suckling. We have done a little of this at Grange where we reared 8 calves per cow to 30 days and then weaned them off. The milk consumption per calf was as low as 15 gallons in some instances. We were very encouraged by the results and we are now developing this work. In this way one could rear 50 or more calves per cow. Much of course, depends on the relative price of milk and concentrate feeding.

ACKNOWLEDGEMENTS

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Suckling for Beef

by

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INTRODUCTION

Data have been accumulated over the last three years on the performance of different breeds and crosses, and on the profitability of different systems of beef production by the M.L.C.

In the first part of this paper the performance of different breeds of bulls and cows in suckler herds is discussed, this is important because the producer of suckled beef has an advantage over producers of beef on systems dependant upon purchasing of stock, in that he has some control over the genetic raw material he is working with.

In the second part of the paper the results achieved in practice and targets for suckler beef production are discussed. Throughout, the suckler enterprise is only considered up to the production of the weaned calf, the subsequent fattening of the weaned calves is not considerd.

PART I

Breed of Sire

Table 1 shows the overall effect of breed of sire on calf performance but takes no account of variations in the breed of cows used or difference in environments in which the sire breeds were used. However,

Table 1
Effect of breed of bull on calf performance

Breed of Bull	No. of Calves	Av. 200 Day wt. (lb).
Aberdeen Angus	1,205	396
Beef Shorthorn	527	375
Charolais	871	479
Devon	559	462
Galloway	476	370
Hereford	1,467	420
Lincoln Red	349	472
South Devon	454	481
Sussex	298	481
Welsh Black	270	420

Table 2
Effect of breed cross of cow on calf performance

contemporary comparison analyses confirm not only the ranking of the breeds but also the magnitude of differences between them.

Clearly breed of sire has marked influence on calf performance even at the fairly early 200 day stage.

The top group of breeds comprising the South Devon, Sussex, Charolais, Lincoln Red and Devon, produced calves with average 200 day weights in the range 462-481 lb. Hereford and Welsh Black crosses averaged 420 lb. Aberdeen Angus crosses were 24 lb. and Beef Shorthorn crosses 45 lb. lighter than Hereford or Welsh Black crosses. The Galloway, which should probably not be regarded as a top crossing sire, produced the lightest calves weighing 370 lb.

It is interesting that the breed rankings follow closely the ranking of breeds on the basis of their mean bull 400 day weights. (Fig. 1).

This also shows the considerable variation in performance within each of the breeds. About 50 per cent of bulls licenced in Britain in 1969 will be weight recorded. It is important that producers use all the available information when purchasing a herd sire.

Breed of Cow

There are numerous types of cows used for suckled beef production both within and between herds. Results indicate the marked superiority of the beef breed x Friesian over the more traditional beef cow typified by the Blue-Grey; Hereford and Aberdeen Angus crosses with the Ayrshire and the Hereford Dairy Shorthorn also ranked above specialised beef cows. (Table 2).

Breed Cross of Cow	No. of Cows	Av. 200 Day Wt. of calves (lb)
Aberdeen Angus × Ayrshire	127	441
Aberdeen Angus × Shorthorn	126	437
Aberdeen Angus × Friesian	415	452
Aberdeen Angus × Other Beef Breeds	213	430
Blue-Grey	777	431
Charolais × Friesian	301	480
Hereford × Ayrshire	170	456
Hereford × Shorthorn	173	450
Hereford × Friesian	868	468
Hereford × Other Beef Breeds	326	434
Galloway × Other Beef Breeds	128	411
Red Breed × Friesian	245	483
Beef Shorthorn × Other Beef Breeds	141	425

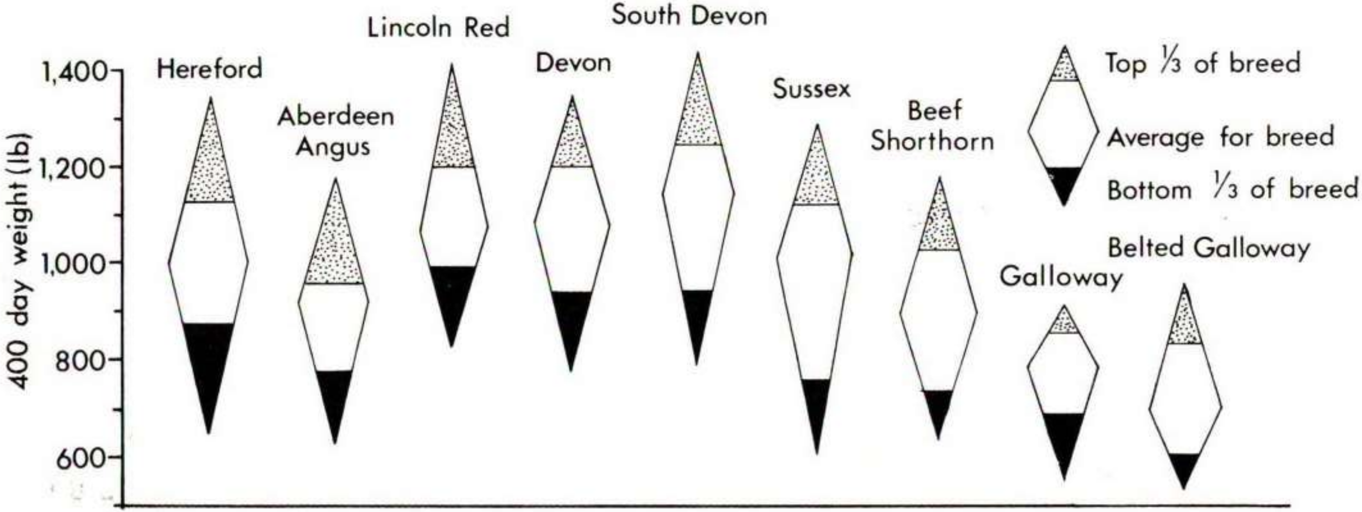

Fig 1 : Mean Bull 400 day weights

Within beef breed x Friesian cows, the sire breeds in the cross ranked in much the same order as in the overall analysis of breed of sire on calf performance.

Type of Farms

The results in Table 3 show the expected decline in calf performance as the environment worsens. The decline from upland to hill farms is particularly severe but is partly a function of the breeds used on hill farms.

One interesting feature is that the decline in performance of heifer calves is less severe than for bull calves. This may reflect a greater resilience in the female under conditions where nutrition is inadequate.

Relationship between the Breed of Sire and Farm Situation

The ranking of breeds of bull and the magnitude of difference between breeds are not much influenced by mating with beef breed x Friesian on specialised beef cows.

The ranking of breeds of sire are the same on lowland, upland and hill farms but the difference between breeds declined on upland farms and were reduced appreciably on hill farms. (Table 4).

Relationship between Breed of Cow and Farm Situation

The decline in superiority of the beef breed x Friesian cow from lowland to upland farms is only slight (Table 5). However, on hill farms the beef breed x Friesian shows only a marginal advantage over the specialised beef cow. This illustrates the restricting influence which environment places on the expression of potential.

Relationship between Breed of Bull and Breed of Cow

The order of ranking of sire breeds is essentially the same for matings with beef breed x Friesian and specialised beef cows. Table 5 also shows the consistent superiority of performance of calves from beef breed x Friesian cows referred to earlier.

The three way cross appears to have an advantage (Table 6) over the two way cross. These are contemporaries; the $\frac{3}{4}$ Hereford steer calves were 29 lb. lighter than $\frac{1}{2}$ Hereford steer calves at 200 days of age, the respective difference for heifer calves was 30 lb.

Conclusion to Part I

Data collected to date has been primarily concerned with liveweight gain of suckled calves. Obviously other factors such as calving percentage or calf mortality are of importance as is the useful productive life of different crosses of cow in different environments. Data are now being collected on these other characters. Surprisingly little is known of the weight of the various cross bred cows and a weighing programme

Table 3

Performance of calves from lowland, upland and hill herds

Type of Herd	No. of Calves		Ave. 200 Day wt.	Range
Lowland	4,871	Steers	483	228–770
		Heifers	453	187–660
Upland	5,804	Steers	452	196–678
		Heifers	425	178–641
Hill	1,457	Steers	363	162–546
		Heifers	349	158–518

Table 4

Weights of calves from different breeds of bull on lowland, upland and hill farms

Breed of Bull	Av. 200 Day Wt. of Calves (lb) Lowland	Upland	Hill
Aberdeen Angus	426	398	338
Beef Shorthorn	402	389	328
Charolais	508	465	379
Galloway	—	388	336
Hereford	452	415	367
Red Breeds	495	467	370
South Devon	497	467	—
Welsh Black	—	440	376

Table 5

The weight superiority of calves from Beef × Friesian cows over those from specialised Beef cows

Breed of Bull	Weight Superiority (lb) Lowland	Upland	Hill
Aberdeen Angus	+15	+15	+6
Beef Shorthorn	+20	+21	+8
Charolais	+30	+24	+4
Galloway	—	+16	+2
Hereford	+33	+26	+4
Red Breeds (Devon, Lincoln Red, Sussex) ...	+30	+25	+7
South Devon	+37	+17	—
Welsh Black	—	+13	+13

Table 6
Performance of calves from Hereford Friesian cows

Breed of Bull		No.	Average 200 Day Weight
Hereford	Steers	75	467
	Heifers	63	438
Other breeds	Steers	79	496
	Heifers	57	468

commenced this Autumn to collect information on this point. This information will be of value in determining feed requirements for different types of cow. The most striking finding to date is the strong influence of the sire breed on calf performance during a period when the dam has generally been regarded as having the dominant influence. In this respect the moderate ranking of the Hereford, numerically the most important beef breed, is disappointing.

PART II—Results and Targets for Lowland Herds

Liveweight Gain

The choice of type of bull and cow in suckler beef production is important because there is a close relationship between calf liveweight gains and gross margin.

Tables 7 and 8 show the results from recorded herds in 1968. The top third herds produced the highest output, both physically and financially. The difference in the average weaning weight of calves

Table 7
Physical results of the study groups

Calving Interval (days)	Calving %	Mortality %	Weaning Wt. (lb) Average	D.L.W.G. to Weaning (lb)	Stocking rate acres/cow	L.W.G. per acre (lb)
366	94	5	540	1.9	1.6	357
			Range			
325–380	78–100	0–14.6	370–750	1.3–2.4	0.8–3.4	179–603
			Top ⅓			
345	96	2.4	589	2.0	1.2	515
			Bottom ⅓			
372	92	8.8	481	1.7	2.2	229

Table 8

Financial results of the study groups (to nearest £)

		Variable costs (£)						Output (£)					Gross margin (£)	
		Winter feed for cow	Creep feed	Grazing	Total feed and forage costs	Vet. and Misc.	Total variable costs	Sales	Subsidy	Less depreciation	Mort.	Output	Per cow	Per acre
Average	A	11	2	5	18	3	21	44	12	4	2	51	30	19
	S	10	2		17		20	45	10			49	29	19
Range	A	4-28	0-9	0-12	6-32	0-12	6-43	27-61	7-22	1-14	0-10	29-63	14-48	5-49
	S	3-27	0-8		5-31		6-43	27-62				33-66	2-47	1-49
Top ⅓	A	11	3	5	19	1	20	46	12	5	1	53	33	29
	S	10	3		18		19	48	10			53	34	30
Bottom ⅓	A	15	1	5	21	5	26	40	13	4	3	47	22	11
	S	17	1		23		28	39	10			43	16	7

A = Actual Costs. S = Standard Costs.

Table 9

Relationship between date of calving and gross margin per cow

Period of calving	No. of herds	Standardised gross margin per cow (£) Average	Range
Winter/Spring	34	24.6	2.2–39.7
Autumn	10	34.3	27.5–52.2
All Year	6	19.5	16.3–25.9

between the top and bottom third herds was 108 lb. and the difference in output was £6 per cow. On average for every 0.1 lb. per day increase in daily liveweight gain in winter/spring calving herds, the gross margin was increased by £1 18s.

Date of Calving and Feed Costs

Table 9 shows the average gross margin in 1968 for herds calving in different periods. Autumn calving herds were the most profitable, reflecting the greater output from these herds.

However, date of calving should be related to the individual farm situation, i.e., feed available, buildings and labour etc. If the right choice of calving period for a particular farm is made, then gross margins should not differ greatly with calving period.

Calving periods must be planned and the bull should be allowed to run with the herd for a limited period only to ensure calving dates do not spread throughout the year. The herds with all year calving had the lowest gross margins per cow. Planned calving is necessary for feed levels to be related to the herd's need and also it ensures even batches of calves at the sales.

Cow Feed Costs

It is essential that the feeding of the cow is related to the date of calving. The aim with spring calving cows should be to feed at maintenance level during the winter, then gradually increase the level of nutrition during the last month of pregnancy. Autumn calving cows must be fed on a sufficiently high plane of nutrition during the winter to maintain milk yields. Results for 1968 showed no relationship between feed costs per cow and the weight of weaned calf (Table 10) or the date of calving (Table 11).

The results show that many autumn calving herds are being under fed during the winter, and that many spring calving herds are being over fed.

Creep Feeding

Results from different farms both commercial and experimental, reflect differences in response to creep feeding. The response will be related to

Table 10

Relationship between Winter feed costs per cow and weight of weaned calf

	10 herds with heaviest calves	10 herds with lightest calves
Average weight of weaned calf (lb)	641	415
Average feed cost per cow (£)	10.5	11.4

Table 11

Relationship between date of calving and feed costs per cow

	Winter/Spring calving herds (34)	Autumn calving herds (10)	All Year calving herds (6)
Av. cow feed costs (£)	12.4	8.9	10.1
Herd range	4.3–27.9	5.7–13.6	5.4–15.6

the potential for growth of the calves and the milk yield of the cows. The overall response to creep feeding in recorded herds is plus 42 lb. for steers and plus 38 lb. for heifers.

The response to creep feeding is closely related to season of calving and this factor is important in determining the economics of creep feeding in the herd. (Table 12).

Table 12

Relationship between season of calving, creep feeding and weaning weight

December–May Calving (lb)				June-November Calving (lb)			
No.	Creep	No creep	Response	No.	Creep	No creep	Response
			Steers				
1,081	460	435	+25	768	449	396	+53
			Heifers				
968	408	387	+21	637	402	361	+41

The response to creep feeding with calves born in the period December-May is lower than the response for calves born in the period June to November. This is a reflection of the age of the calf in relation to the lactation of its dam when creep feed is introduced. Creep feeding will generally be justified economically in autumn calving herds, but should only be necessary in limited amounts in spring calving herds. There is a strong need to improve both grazing and conservation management, irrespective of date of calving.

Targets

Systems for autumn calving and spring calving herds with targets are given in Figs. 2 and 3 and Tables 13 and 14.

Table 13

Suckler herd targets Autumn calving

Gross margin per cow	£43
Gross margin per acre	£30
Stocking rate	1.4 acres per cow
Liveweight gain of calf	2.3 lb per day
Weight of weaned calf	725 lb

Table 14

Suckler herd targets—Spring calving

Gross margin per cow	£38
Gross margin per acre	£30
Stocking rate	1.3 acres per cow
Liveweight gain of calf	2.5 lb per day
Weight of weaned calf	605 lb

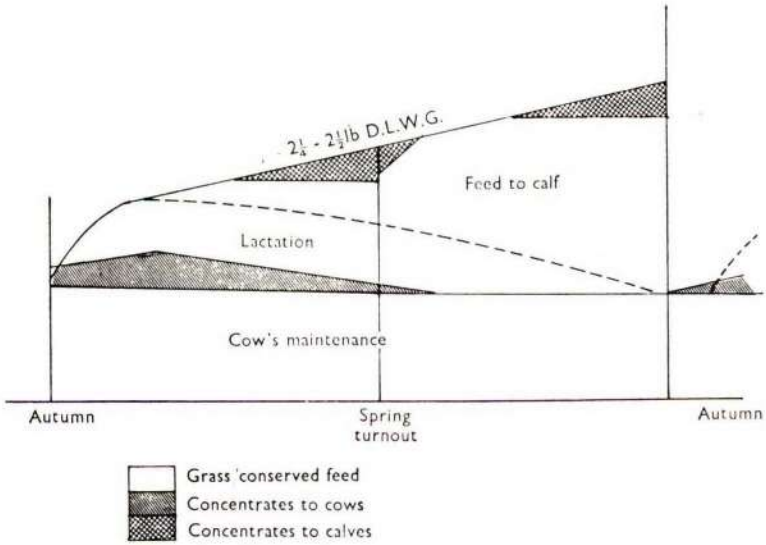

Fig 2 : System for autumn calving suckler herd

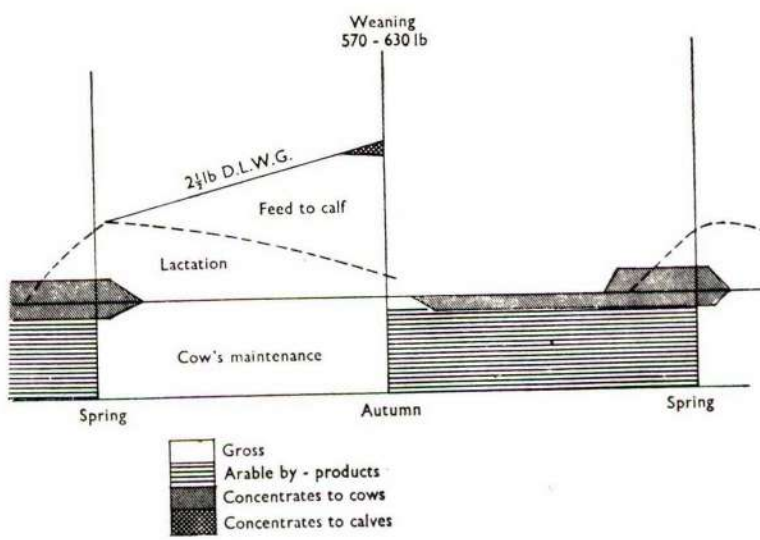

Fig 3 : System for spring calving suckler herd

Cattle Production from Grass and Silage on Irish Farms

by

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The wintering of cattle is a very important stage in any system of production. There is a very close relationship between profitability and liveweight gain in wintering systems, especially where low cost foods such as silage or hay form a large part of the diet. A simple example will illustrate this point. We all know that the price of cattle appreciates by 30/- per cwt. from Autumn to Spring. If an 8 cwt. bullock puts on no weight during the winter he increases in value by about £12 (8 x 30/-). Since it costs about £10 to winter this type of bullock it is obvious that the margin of £2 is not a very attractive proposition. Suppose the same bullock gained one cwt. in weight during the winter his increase in value is now in excess of £20. It is important to remember that this cwt. increase can be got from good silage or hay alone and so at little extra cost.

In order to find out the level of performance obtained on Irish farms, a survey was carried out during the winter of 1966/67. Twenty one farms in counties Carlow, Kilkenny, Wexford, Kildare, Dublin, Louth, Meath and Westmeath, wintering almost a thousand cattle, participated in the survey.

There were 27 groups of cattle in all, varying in number from 10 to 128 and averaging 34. Most of the animals were store bullocks weighing from 7 to 9 cwts. There were a few groups of weanlings. The average feeding period was 107 days varying from 41 to 148 days. All animals were individually weighed with a mobile scales shortly after the start of winter feeding and again just before winter feeding finished.

Feeding Programme

The basic feeding regime for the 27 centres was as follows:

(a) Self-fed silage, 21 centres
(b) Silage and hay ration, three centres
(c) Hay and swedes, one centre
(d) Hay only, one centre
(e) Barley straw and swedes, one centre.

Details of the feeding are given in Table 1.

Table 1

Details of feeding and worm treatments at the 27 centres

Main Roughage	Supplements	Centre No.	Stomach worm treatment	Liver fluke treatment
Self-fed silage	(i) None	1	Mid-Dec.	Early Jan.
		2	None	None
		3	3/11 & 19/12/66	3/11 & 19/12/66
		4	None	22/12/66
		5	Dec.	Dec.
		6	Dec.	Dec.
		7	None	None
		8	None	None
		9	None	Mid-Dec.
		10	None	None
	(ii) Minimum/poor hay	11	Mid-Dec.	Late Dec.
		12	None	None
	(iii) 4–5 lb swedes 1 lb meals	13	None	None
	(iv) 1–2 lb meals	14	Mid-Nov.	None
		15	None	None
	(v) 3–5 lb meals	16	None	None
		17	None	None
		18	None	None
		19	None	None
		20	None	None
		21	Jan. & Feb.	Jan. & Feb.
Silage/hay ration	(vi) 14 lb silage, 14 lb poor hay for 56 days replaced by 18 lb poor hay + 3 lb meals + 1 pt Liquafeed + minerals	22	Jan. Feb.	Nov. & Dec.
		23	None	None
	(vii) Same as (vi) except good hay was fed	24	None	None
Hay	(viii) Hay ad lib. + 5.8 lb swedes + 1 lb meal	25	Sept.	Sept.
	(ix) 16 lb hay + 6.8 lb meal	26	Sept	Sept.
Straw/swedes	(x) Good barley straw 50 lb swedes for 100 days replaced by 14 lb medium hay + 7–12 lbs meals	27	Sept.	Sept.

Silage quality

At all centres, with the exception of two, silage was made in the conventional haybarn roofed silo. There was no additive used and no wilting was carried out. Silage at all centres was sampled and chemically analysed. The range and average chemical analysis of the silages was as follows:

	Range	Average
Dry matter content (percent)	16 to 24.8	18.5
Crude protein (percent in dry matter)	9.4 to 16.1	11.8
Decomposed Crude Protein (percent in dry matter)	0.1 to 4.8	1.8
PH	3.7 to 5.0	4.3

The average dry matter at 18.5 per cent. must be considered low especially since much of the silage was made from fairly mature grass. The crude protein average of 11.8 per cent., including decomposed crude protein, was also low. The ammonia fraction in many of the silages was much too high. Though the average PH of 4.3 was satisfactory it was above 4.7 in 25 per cent. of the silages.

In addition to the chemical analysis a visual assessment was made of all silages. With this information on silage quality a prediction was made of the expected liveweight gain at each centre.

Housing

All groups of animals with the exception of one were housed for the entire survey period. Most of the housing consisted of lean-to type sheds but there was much variation in housing conditions between farms. The one outwintered group had access to a well sheltered paddock.

Treatment for Control of Stomach Worms and Fluke

Three groups were treated twice and seven groups treated once for the control of liver fluke and stomach worms. Two groups were treated once for fluke and one group received one treatment for stomach worms. Fourteen of the twenty seven groups received no treatment whatsoever for the control of stomach worms or liver fluke.

Results of the Survey

The majority of participants in the survey were interested in obtaining substantial liveweight gains, as most of them hoped to sell their cattle out of the yards or after a short period at grass. (Table 2 contains details of the survey).

Table 2

No. of centre	1	2	3	4	5	6	7	8	9	10
No. of days	90	72	120	97	97	97	99	99	104	146
No. of Animals	30	35	46	50	128	35	62	46	50	25
Mean Wt. at start (lb)	893	877	816	804	844	752	1,007	1,010	647	486
Wet range at start (lb)	750/ 1,020	775/ 1,020	660/ 995	637/ 917	705/ 995	600/ 865	900/ 1,125	920/ 1,135	469/ 770	420/ 600
Mean daily live wt. gain lb	1.3	0.75	0.53	0.44	0.45	0.14	0.16	0.10	–0.18	0.17
Animals that lost wt. (%)	6	3	0	20	16	34	38	43	64	20
Animals that had no permanent teeth at start (%)	23	50	80	64	64	85	6	10	100	—
Silage Analysis										
Dry matter	24.80	18.30	21.50	16.90	17.40	16.10	18.10	16.0	19.0	19- 20
Crude protein	9.60	12.30	10.90	10.30	13.0	8.70	7.70	11.90	13.10	10.0
Dec. Cr. protein	0.10	1.30	0.40	1.70	2.30	1.50	4.80	4.20	2.40	—
PH	4.30	4.30	3.80	4.00	4.60	3.70	5.0	4.70	4.30	3.80

No. of Centre	11	12	13	14	15	16	17
No. of days	115	95	98	41	90	115	115
No. of Animals	51	22	23	14	11	22	24
Mean wt. at start (lb)	791	1,003	1,010	968	1,060	903	403
Wt. range at start	535/ 1,070	900/ 1,140	905/ 1,150	850/ 1,080	916/ 1,148	635/ 1,045	395/ 610
Mean daily live wt. gain (lb)	1.2	1.0	0.33	1.17	0.46	0.50	0.50
Animals that lost wt. (%)	0	0	35	0	0	20	0
Animals that had no teeth at start (%)	72	36	9	14	36	60	100

TABLE 2 (Continued)

Silage Analysis										
Dry matter	20.1	20.5	20.2	18.8	20.4	16.0	18.0			
Crude protein	13.9	10.1	7.7	10.5	9.1	9.0	12.0			
Dec. Cr. protein	0.5	0.3	3.0	3.5	0.7	—	—			
PH	3.8	3.7	5.0	5.0	4.2	4.4	4.2			
No. of Centre	18	19	20	21	22	23	24	25	26	27
No. of days	97	148	120	146	146	130	130	98	98	98
No. of Animals	51	39	25	15	20	36	16	10	10	25
Mean wt. at start (lb)	1,064	318	990	873	412	602	953	605	592	360
Wt. range at start (lb)	960/ 1,150	225/ 540	780/ 1,010	755/ 1,030	285/ 535	385/ 840	790/ 1,200	435/ 710	510/ 760	275/ 45
Mean Daily live wt. gain lb	0.18	0.14	0.10	0.12	0.73	0.66	1.3	0.92	0.50	1.14
Animals that lost wt. (%)	41	25	36	20	0	5	0	0	10	0
Animals that had no teeth at start (%)	8	100	36	—	100	100	75	100	100	100
Silage Analysis										
Dry matter	19	20	20.90	—	—	—	—	21.10	21.1	21.10
Crude protein	8.0	10.0	7.20	—	—	—	—	11.20	11.20	11.20
Dec. Cr. protein	3.10	—	2.20	—	—	—	—	1.0	1.0	1.0
PH	4.90	4.0	4.90	—	—	—	—	4.10	4.10	4.10

Liveweight Gain

The striking feature of the survey results was the poor liveweight gains obtained. In nine of the groups the average daily liveweight gain was less than .20 lb. In 17 of the 27 groups, there were some animals which lost weight. In fact, there were 12 groups where 20 per cent. or more of the animals lost weight. Of the 10 groups that were fed silage alone, the average daily gain was less than .20 lb. in five of those. Only one of those silage alone groups gained more than an average of one lb. per day.

There were only five groups in all where the average daily gain was over one lb. per day. This very poor picture of liveweight performance is one of real concern.

Range in Liveweight Performance

The range in liveweight performance of animals within groups was quite large. There were many groups in which the worst animals lost ¾ cwt. or more and the best animal within the same group gained over one cwt.

Silage Quality

As stated earlier the quality of many of the silages was low. In fact, the quality was rated poor in 40 per cent. of the cases. Undoubtedly many of the silages were far too mature when cut. However, other major causes of the disappointing quality lay in the lack of application of known practices in silage making. These causes were as follows:

1. Speed of filling—there were many instances where it took up to two weeks to fill pits of 130 to 140 tons. It is almost impossible to make high quality silage in this way.
2. Soil contamination—this was evident in many of the pits. The reasons for this were (a) large amounts of soil brought in to the dumping area on the wheels of tractors in wet weather. This soil eventually gets into the pit.
3. Failure to reduce losses in the pit—it is necessary to seal off the pit quickly and effectively. Plastic sheeting was not used in some silos. In some cases where it was used it was either put on two or three days after filling or was not weighted down properly.

Stomach, Worm and Liver Fluke Treatment

On the basis of quality of the foods fed, the performance of nineteen of the twenty seven groups was below that expected. It is interesting to note that thirteen of the fourteen which received no dosing are to be found in this group of nineteen. Of the eight groups where production was as good as could be expected, six of these were treated at least once for the control of liver fluke and stomach worms.

Table 3

Group No.	1	1	2	3	4	4	5	6	7	8
No. of Animals	33	33	33	47	40	40	46	46	28	17
Stocking Rate (ans/acre)	2	2	2	1	1.3	1.3	1.5	2	2	2 reduced 1.2
Mean wt. at start lb	825	825	956	987	688	688	858	880	800	600
Grazing period	April 24 to June 6	April 24 to July 7	April 17 to June 6	April 17 to May 27	May 2 to June 21	May 2 to Nov. 15	March 23 to May 21	April 7 to June 6	April 3 to July 19	April 5 to Nov. 2
Main Daily Gain lb	3.50	2.75	2.05	3.10	3.50	2.10	2.60	2.75	2.40	1.83

Some General Comments

Only two groups of animals were treated for the control of lice. Lack of such control could be responsible for reduced liveweight gain in some cases. It is interesting to note that within groups, there was no consistent relationships between production and presence of permanent teeth at the start of winter feeding.

At some centres where the results were disappointing the silage appeared very dense. Silage density must be taken into account when self feeding if satisfactory daily liveweight gain is to be achieved. The length of feeding face appeared to have limited intake and so reduced production in some cases. The effect on production of silage density and length of feeding face are inter-dependent and so should not be considered in isolation. The housing conditions were generally adequate, except at three centres where very draughty conditions obtained. At these three centres production was below that expected.

To sum up, I would say that the major causes of the poor production were as follows:

1. Poor silage quality.
2. Complete lack of or inadequate treatment for liver fluke and stomach worms.
3. Reduced silage intake because of silage density.
4. Absence of lice control.
5. Draughty housing.

As a follow-up to the 1966-67 survey, a further programme was planned for the winter of 1967-68. Unfortunately, because of the foot and mouth outbreak in the U.K. the restrictions imposed here lead to the abandoning of the work and results are available from only 11 farms with 13 groups of animals.

In the case of this 1967-68 project, the aim was to ask co-operating farmers to follow certain guidelines with respect to silage-making, cattle dosing and general husbandry, and to see whether it was possible to attain at farm level, the winter liveweight gains which had been reported by research workers.

The results can be briefly summarised as follows:

1. There was a very substantial improvement in liveweight gain. In over 50 per cent. of the groups the liveweight gain was in excess of one lb. per day.
2. A greatly improved approach to the use of anthelmintics obtained.
3. Though the average dry matter, crude protein and PH of the silages differed only slightly from the survey figures the quality was greatly improved. This was because much greater care was taken at silage making time.
4. The range in performance of animals within groups was reduced to reasonable proportions.
5. There were only two centres where animals lost weight. These, incidentally, were at the only two centres where the silage fermentation was rated poor.

To obtain satisfactory liveweight gain from self-feed silage it is necessary to provide a good quality silage with adequate feeding face per animal taking into account silage density. In addition to the normal day to day management/husbandry practices, it is important that a proper programme for the control of stomach worms, liver fluke and lice be carried out.

The very poor production obtaining on very many farms can be substantially and quickly improved by simple attention to some vital husbandry factors. It is important that this improved production takes place quickly.

In conclusion Table 3 gives a brief outline of some of the results to date from the grazing animal. These figures show that we have been more successful with the grazing animal than with the silage fed animal in our efforts to achieve satisfactory liveweight gains.

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Beef for the Mid-Seventies

by

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The question is what kind of beef carcases will be required for the nineteen seventies? I will attempt to answer this question by listing the carcase characteristics which might be taken into consideration when evaluating beef in the next decade and then discuss each characteristic in turn. As a result of this discussion, I hope to be able to suggest to you what kind of beef is going to be needed for the future.

The characteristics, which might be considered in carcase evaluation are:

1. Carcase weight
2. Carcase composition
3. Carcase conformation
4. Meat quality
   (a) Colour of fat and lean when fresh
   (b) Waterholding capacity of lean when fresh and cooked
   (c) Tenderness of lean when cooked
   (d) Juiciness of meat when cooked
   (e) Flavour of meat when cooked

Carcase weight

The method of retail cutting practiced in the British Isles demands a relatively light carcase of about 500 lb. if the rolled roasts from along the back are to have a reasonable depth when cut into family joints. The heavier the carcase the shallower the rolled roast must be for any given joint weight. Of course, this problem does not arise when you are providing roasts for the catering trade.

About thirty three per cent. of a carcase goes into roasting joints and carcase weight has no effect on the quality of the other joints. So one can assume that in the British Isles the retail butcher demands a light carcase because small roasts of depth can be cut from it. However, another factor, which retail butchers may sub-consciously be taking into consideration in demanding light carcases is that within the same breed or cross and sex the heavier the carcase the fatter it is.

On the other hand, the French method of cutting for the retail trade demands a heavy carcase of about 800 lb. The reasons for this are:

(a) Their method of cutting is virtually a muscle by muscle dissection of the carcase. The smaller muscles make reasonable joints from 800 lb. carcases, but are hopelessly thin from light carcases.
(b) With this method of cutting the same amount of skilled labour goes into cutting a carcase whether it is light or heavy.
(c) The French in their beef demand the full-bodied beef flavour, which can only be had from mature animals.

If a dropped calf costs twenty pounds (400 shillings) and the animal is killed at 400 lb. carcase weight then the charge on the carcase for the calf is a shilling a pound. If killed at 600 lb. carcase weight, it is eight pence a pound and six pence a pound if killed at 800 lb. There are other economic considerations to be taken into consideration when looking at the economics of producing carcases of different weights, but I often get the impression that the differential paid for light carcases may not be enough to cover the extra costs.

I think more and more in the future, farmers will be inclined to market their cattle at carcase weights which give lean meat production at the least cost per pound and they will only be willing to change from this if the butcher is willing to pay a worthwhile differential for lighter or heavier carcases. Butchers may find that they will not be able to afford to pay this differential for what may be a marginal difference in quality namely, the depth of a rolled roast of beef.

Carcase composition; fat; lean; bone

To illustrate the points I wish to make about carcase composition and conformation I am going to use data from Dr. Harte's* experiments, which were carried out at Grange Research Station of the Agricultural Institute. In these experiments, he was comparing the performance of Friesian, Hereford X Shorthorn and Aberdeen Angus X Shorthorn bullocks. See Table 1. In experiment one, the Friesian Hereford Cross and Aberdeen Angus Cross animals were killed at 1,200, 1,100 and 1,000 lb. liveweight respectively. In experiment two, the animals were killed at an equal age of 737 days.

Carcase composition

The carcase composition of these animals are given in Table 2. From this table, it can be seen that the fatter the animal, the less lean in the carcase. Any method of carcase grading, which gives marks for fat over and above that amount of fat, which is required for cooking, is bound to be unrealistic as it is favouring a reduction in lean percentage. There is a great need at the moment for a detailed market survey on carcase fat requirements and the price differential that would be paid for carcases of different fatness.

* Breed type, castration and plane of nutrition in calfhood as factors affecting efficiency in cattle production. Ph.D. thesis, University of Dublin, 1966.

An increase in bone in the carcase decreased the amount of lean in the carcase in exactly the same proportion as does an increase in fat of the same amount. Despite this, butchers seem to down grade heavy boned animals much more than fat animals. Also, the fatter the animal the less bones will be in a carcase. In comparing the bone size of breeds of animals I think it is very important to compare them on a muscle to bone ratio basis. In Table 3, I have calculated the carcase composition, disregarding fat and I have calculated the "lean" to bone ratio. You will see how the Friesians compare unfavourably with the other two breed crosses, but because they have less fat in their carcases, they have a much more favourable lean content (see Table 2).

Carcase conformation

All lean in a carcase is not of equal commercial value. The roasting meat is of less value per pound than the frying meat and the stewing meat is of less value still. Because of this, the animal with the highest percentage of its total lean in the expensive cuts is the best. This is one of the basis on which live animals and carcase conformation is judged. In Table 4, I have calculated the lean in each cut as a percentage of total lean in the carcase for the three types of animal.

It is obvious that there is very little if any difference between these three types of animal when conformation is accessed in this way. The Aberdeen Angus crosses have significantly more round than the Herefords in experiment one and less shin than the Friesians in experiment two. Good points in favour of the Aberdeen Angus crosses. The Friesians have significantly less flap in both experiments and less clod and sticking in experiment two both credit points to the Friesians as these are cheap cuts.

Conformation may also be measured in a different way. It is possible to have two animals with the same percentage of total carcase lean in the round or along the expensive cuts of the back but having different lengths of leg or back. The animal with the shortest length will have the thickest fleshing. This may be a quality factor. I doubt if it is important in beef cattle where one side may be cut into as many a 50-100 family joints. It could be more important in lamb and pork.

Meat Quality

Some people speak about carcase quality as if it were independent of meat quality which it is not. Meat quality is an important factor in carcase quality.

Colour of fat

In most markets, a pale creamy fat colour is sought after. Excessively yellow fat is undesirable and the consumer may associate it with cow beef.

Table 1

Age and liveweight at slaughter

	Friesian		Hereford × Shorthorn		Aberdeen Angus × Shorthorn	
	Age days	Weight lb.	Age days	Weight lb	Age days	Weight lb
Experiment I	723	1,183	695	1,098	659	992
Experiment II	737	1,041	737	1,049	737	975

Table 2

Carcase Composition

	Experiment	Friesian	Hereford × Shorthorn	Aberdeen Angus × Shorthorn	F Test
Fat	I	15.3	22.8	21.1	**
	II	14.1	19.4	23.4	***
Lean	I	71.1	65.8	67.0	***
	II	70.7	67.7	65.3	**
Bone	I	13.6	11.5	11.9	***
	II	15.0	12.7	11.6	***

Table 3

Carcase composition disregarding fat

	Experiment	Friesian	Hereford × Shorthorn	Aberdeen Angus × Shorthorn	F Test
Lean %	I	84.0	84.8	84.9	N.S.
	II	82.5	84.1	84.9	***
Bone %	I	16.0	14.9	15.1	N.S.
	II	17.4	15.9	15.1	***
'Lean': Bone	I	5.3	5.6	5.6	*
	II	4.7	5.3	5.7	***

Table 4

Lean in each cut as percentage of total lean

Cut	Experiment	Friesian	Hereford × Shorthorn	Aberdeen Angus × Shorthorn	F Test
5, 6, 7 Rib	I	5.7	5.5	5.7	N.S.
	II	5.4	5.1	5.3	N.S.
8–9 Rib	I	3.7	3.9	3.8	N.S.
	II	3.6	3.6	3.6	N.S.
10th Rib	I	1.8	1.9	1.6	N.S.
	II	1.7	1.8	1.6	N.S.
Loin	I	6.4	6.4	6.6	N.S.
	II	6.4	6.5	6.6	N.S.
Round	I	32.7	31.0	32.9	*
	II	31.7	30.8	30.7	N.S.
Brisket	I	6.5	6.3	6.3	N.S.
	II	6.4	6.3	6.2	N.S.
Plate	I	1.3	1.4	1.3	N.S.
	II	1.5	1.4	1.5	N.S.
Flap	I	7.5	8.7	8.4	***
	II	7.6	8.0	9.1	***
Chuck	I	12.6	12.6	12.0	N.S.
	II	14.6	14.4	14.0	N.S.
Clod & Sticking Fore & Hind shin	I	21.9	22.3	21.6	N.S.
Clod & Sticking	II	13.4	14.7	14.1	**
Fore Shin	II	2.7	2.7	2.6	N.S.
Hind Shin	II	5.0	4.8	4.6	*

Colour of lean when fresh and cooked

Colour of lean when fresh is most important as the housewife is attracted by cherry red colour at the point of sale. I think we will hear a lot more about this colour in the next decade because colour fade in prepacked fresh meat is one of the limiting factors in the shelf life of the prepacked product. Lengthening the shelf life of prepacked fresh meat is the challenge of the moment.

We do not know nearly enough about the factors affecting colour in beef although we do know that the method of slaughter in pigs influences the colour. In fact, by measuring the acidity of pork within an hour after death, you can predict with reasonable accuracy what the colour of the fresh pork will be days later. We do know that this same measurement taken 24 hours after slaughter tells us a lot about the colour of the fresh beef, but it may not tell us everything.

Colour of the lean when cooked

You all know the story of the objection to the pale colour of barley beef when cooked. How acceptable this is compared with the darker colour of meat from more mature animals, it is hard to tell. My opinion, for what it is worth, is that barley beef is acceptable to a certain market where its tenderness characteristics outweigh the disadvantage of its lack of maturity.

Waterholding capacity of lean

The waterholding capacity of meat is important firstly, because, if it is poor, the freshly cut meat will ooze bloody looking moisture when displayed for sale or prepacked. Secondly, there will be excessive cooking losses and the meat will not be good for canning and sausage making. As in the case of colour of the fresh meat, the published literature on the factors influencing the waterholding of pork meat is far more extensive than in the case of beef, although some private companies may have considerable informaton on beef. As in the case with colour in pork, the acidity of the meat soon after slaughter will indicate whether the waterholding capacity of the meat will be good or not. It is not known whether this holds good for beef or not, but it is known that low acidity twenty-four hours after slaughter is associated with dark coloured sticky beef, which has a high waterholding capacity.

Tenderness

I need not emphasise how important a quality tenderness is. However, there is need for market research work to be carried out, which would answer the question: What is the relative importance to the consumer of tenderness as compared to flavour?

In America, it is well established that the British Breeds of beef cattle are more tender than cattle with Bramen blood and there are indications that, within breed, tenderness is an inherited character.

A former colleague of mine in the Agricultural Institute, Dr. Hill, has shown why beef gets tougher as the animal gets older. Collagen, of which connective tissue is made, is responsible for a considerable amount of the toughness of meat. On cooking in the presence of moisture, the collagen turns to gelatin. Dr. Hill has shown that as the animal gets older, the solubility of the collagen decreases. This means that in cooking, less of the tough collagen is converted to gelatin.

There is conflicting evidence on the role of marbling fat in influencing toughness in meat. There seems to be little reason why it should influence the toughness of meat. Whether marbling influences the juiciness of meat is also open to question. We, in the Agricultural Institute regard toughness as a wide open field for research.

Flavour

Flavour is important, but how important compared with tenderness or colour of the fresh meat needs to be answered by the market research people. I know little about it that I can usefully discuss with you today.

Beef for the nineteen seventies will be that which can be produced at the lowest cost per pound of lean taking into consideration the costs from conception to consumption. The carcases will have to be classified so that they can be bought internationally on the 'phone. This classification will be based on:

1. Carcase weight.
2. Sex.
3. An accurate assessment of the carcase fat percentage and some measure of the fat cover distribution.
4. The age of the animal. It may be necessary to leave the teeth hanging on the carcase for this purpose. Or maybe the age may be obtained from the ear tag.
5. A measure of acidity at slaughter or twenty-four hours afterwards or both.
6. If by the 1970s, butchers think that thickness of fleshing is important in a beef carcase and are prepared to pay a differential for it then it may be necessary to describe the amount of lean meat in the carcase per inch of length of back or leg.

The Price Difference between British and Irish Fat Cattle

by

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Cattle are produced in Ireland for both the home and the export market, mainly the United Kingdom. In recent years total exports, including stores, live fats and carcase beef, amounted to 80 per cent. of total cattle output. Store cattle are usually Ireland's most important export. For example, in 1967 618,000 stores were exported, earning £40.5 million. This store trade is a very old one (1). Despite its traditional nature and its importance to Irish farmers and the Irish economy, relatively little is known by non-participants about its operation and efficiency. While such a long established trade is not likely to vanish overnight, there are certain trends in consumer preferences that may adversely affect it in the future. One of these is the preference for lighter carcases. The more prosperous consumer of to-day demands better quality food. The trend in demand for beef is for leaner and more tender meat. These qualities are more likely to be obtained in the young intensively-fed animal than in the traditional slowly grown Irish store (2). English butchers, who are buying to cater for their customers, express a growing preference for the nicely finished nine cwt. bullock by paying an increasing premium per cwt. for them (1).

In view of this preference it is reasonable to enquire if Irish stores are too heavy for the British market? Will the traditional forward store become obsolete as more affluent housewives seek younger beef? On the other hand, if Irish farmers produce the younger animal will it be suitable for the traditional feeder of Irish stores? The aim of this study was to assemble information on price by weight of Irish and British cattle and to assess the extent of the price gap that existed in 1666 between the prices paid to Irish and U.K. farmers.

The Price Gap between British-fattened Irish stores and home-bred animals

Data were collected on the weights and prices of Irish store bullocks fattened in Northumberland and the border counties (2) and of home-bred cattle fattened in the same area. This area is a major importer of Irish store cattle taking between 15 and 20 per cent. of our total store

1. In recent years the gap between the average per cwt. prices of 7-9¼ cwt. bullocks and 9½-11 cwt. bullocks (reported in the Agricultural Market Report, produced by the Ministry of Agriculture, Fisheries and Food) has widened.
2. The counties concerned are Berwickshire, Roxburgh, Selkirk, Peebles, the Lothians and Fife.

exports annually (3). The data consisted of a sample of the 1966 records of a livestock auction market at Edinburgh and of a slaughterhouse at Wooler in Northumberland, one of a national network.

The sampling density differed by market because of the wide differences in the throughputs. The average weekly throughput at Edinburgh was approximately 200, 25 per cent. being of Irish origin. The slaughterhouse at Wooler had an average weekly throughput of 40 bullocks, with varying proportions of fattened Irish steers. A 20 per cent. sample of home-bred cattle and a 50 per cent. sample of fattened Irish stores were taken at Edinburgh for every second week throughout the year. All the records for alternate weeks of 1966 were used in the case of the Wooler slaughterhouse. Heifers were excluded in all cases since the number of heifers of Irish origin was minute relative to home-bred heifers. Records were collected for a total of 2,000 cattle, half of which were sold on a liveweight and half on a deadweight basis. The numbers were also evenly divided according to country of origin.

Results

Irish cattle at Edinburgh averaged 10.8 cwt. compared with 9.4 cwt. for home-breds; the corresponding average carcase weights at Wooler were 677 lb. and 567 lb., respectively. The heavier weight of Irish cattle is well known and compares with the average weight of store bullocks sold in Dublin, at approximately nine cwt. The average weights of fattened Irish and home-bred bullocks at Edinburgh and of store cattle at Dublin are presented in Table 1, and the corresponding Wooler data are given in Appendix Table 1.

The weights of Irish stores at Dublin varies by season, being highest in the Autumn at 9.5 to 10.0 cwt. and lowest in the Spring months at about 8.25 cwt. No such seasonal pattern is evident in the weights of fattened Irish cattle sold at Edinburgh and Wooler. It would appear that British farmers carry Irish stores to about the same weight regardless of the weight at time of purchase. This involves putting on much more weight on spring purchased stores than on autumn purchased ones, which is easy to do in any case because the spring store is typically leaner and emptier than the autumn animal. The large weight gains are probably necessary to secure a satisfactory degree of finish. It is also probably necessary to put more weight on the spring store which is purchased at a high per cwt. price and sold on the falling summer market, in order to maintain profit margins. In contrast to the uniform seasonal weights of Irish cattle, home-breds tend to be heavier in the spring than in the autumn. This is possibly attributable to the better finish on shed-fed animals sold in the spring than on grass-fed animals sold in the autumn.

Irish cattle sold on average for 17/6d. per cwt. less than British, the prices being 173/3d. and 190/9d. per cwt. respectively. The deadweight price of fattened Irish bullocks was 33.5d. per lb. as against

36.3d. per lb for home-bred bullocks, an average price differential of 2.8d. per lb. The principal reason for this price penalty against Irish cattle is their heavier weight. Other contributory factors are: the time of marketing and the high incidence of liver fluke in fattened Irish stores. The prices of both categories of cattle and their associated differentials for Edinburgh and Wooler are presented in Table 2 and Appendix Table 2, respectively.

It is well known that as the weight of cattle increases the price per cwt. usually falls. The edinburgh data were classified by weight into three categories, viz. under 8.5 cwt., 8.5 to 10.5 cwt. and over 10.5 cwt., and the average price for all cattle in each category calculated. The results, together with the distribution of Irish and British cattle by weight category, are shown in Table 3.

The heavier weight of Irish cattle is also evident from Table 3 where nearly 60 per cent. of the cattle of Irish origin exceeded 10.5 cwt., whereas only 13.5 per cent. of the home-bred cattle fell into this category. Deadweight prices and weight distribution at Wooler showed a similar pattern, as may be seen in Appendix Table 3.

When the price of fattened Irish cattle was compared with home-breds of similar weight, the price differential between the two types was insignificant. If anything Irish sold at a premium. The prices of Irish and home-bred cattle are plotted against their weight in Figure 1.

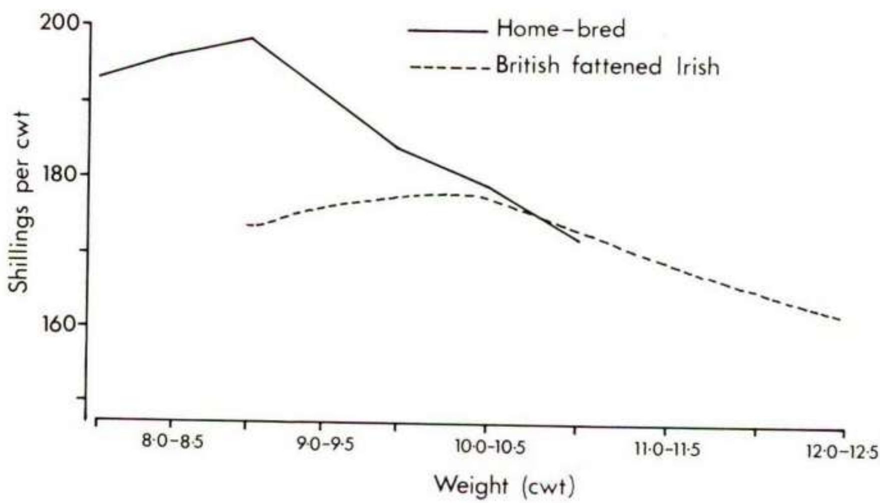

Fig 1: The price of home bred and British fattened Irish cattle in the 7.5 to 12.5 ct. weight range.

Table 1

Average weight in cwt. of British fattened Irish and of home-bred bullocks at Edinburgh, and of Irish store bullocks at Dublin, 1966

	Irish (Edinburgh)	Home-bred (Edinburgh)	Irish store (a) (Dublin)
January	10.8	9.5	9.3
February	10.7	9.5	8.8
March	10.8	9.9	8.2
April	10.9	9.7	8.2
May	10.9	9.4	8.2
June	10.8	9.4	8.9
July	10.5	8.9	9.3
August	10.8	8.8	9.5
September	10.8	9.1	9.6
October	10.6	8.8	9.7
November	11.2	9.4	10.0
December	10.8	9.1	9.2
Annual average	10.8	9.4	9.2

a. The weight of Irish store bullocks was estimated by dividing the price per head of bullocks at Dublin (Store sales) by the price per cwt as published in the Irish Statistical Bulletin, March 1967.

Table 2

Price in shillings per cwt of fat cattle at Edinburgh, 1966

	Home-bred	British fattened Irish	Price difference
January	190.8	178.4	12.4
February	195.2	180.8	14.4
March	193.1	183.0	10.1
April	188.7	181.8	6.9
May	202.7	198.4	4.3
June	208.1	204.1	4.0
July	213.8	200.4	13.4
August	198.7	175.3	23.4
September	175.7	153.1	22.6
October	169.3	142.5	26.8
November	162.5	141.5	21.0
December	173.8	147.8	26.0
Annual weighted average	190.8	173.2	17.6

Table 3
Average price and distribution of cattle by weight at Edinburgh, 1966

	Price (s/cwt)	Home-bred (%)	British fattened Irish (%)
<8.5 cwt	195.6	0.4	32.3
8.5–10.5 cwt	184.5	40.7	54.2
>10.5 cwt	172.4	58.59	13.5
		100.0	100.0

Both categories of cattle have a weight at which the price per cwt. is a maximum. For British cattle this is around 8.5 to 9.0 cwt. and for Irish cattle it is around 10.0 to 10.5 cwt. Below these weight ranges the price per cwt. is lower, presumably because of lack of finish, and above these ranges there is a price penalty, presumably because the cattle are overfat.

The price differential between home-bred and British-fattened Irish cattle is higher in the autumn when cattle prices generally are lowest than it is in the spring. From the data in Table 2 and Appendix Table 2 the average differentials for the first and second halves of the year can be calculated as 8/6d. per cwt. and 21/6d. per cwt., respectively, at Edinburgh, and 1.7d. per lb. and 2.4d. per lb. respectively, at Wooler. The reasons for this seasonal price pattern are probably a mixture of price levelling by butchers and factories, i.e. taking low profit margins when cattle prices are high and substantially higher margins when cattle prices decline, thus eliminating large fluctuations in retail prices, and of reduced discernment by consumers when prices are high. The majority of fattened Irish stores in the U.K. are marketed in the latter half of the year when the price differential is highest. For example, in 1966 68.2 per cent. of fattened Irish stores were marketed in the second half of the year (4). The change in the price gap between spring and autumn is not solely a seasonal phenomenon since the average weight gap between the two categories of cattle also widens in the latter half of the year, as can be seen from Table 1 and Appendix Table 1.

The high incidence of liver fluke in Irish cattle is well known, and all cattle whether infected or not tend to be penalised on account of this disease (5). For example, all Irish cattle sold on a deadweight basis are penalised 0.25 pence per pound. The annual national loss at this rate would approximate £900,000, since undoubtedly British purchasers of Irish stores pass the penalty back to Irish producers, as do buyers on the domestic market.

The Price Gap between Britain and Ireland

In addition to the price gap that exists between prices paid for home-bred and British fattened Irish cattle, there is also a gap between the average Dublin fat cattle price and average U.K. prices. It has been alleged from time to time that the price gap between Dublin and the U.K. is higher than is warranted by transport and marketing costs. In particular, exporters have been accused of weak selling on the U.K. market and of dumping cattle and beef on the market when it is glutted, thereby reducing the returns to Irish farmers.

Part of the evidence used to justify this argument is the difference that exists between the average price, inclusive of subsidy, paid to U.K. farmers for all fat cattle qualifying for the Fatstock Guarantee Payment, and the price of fat cattle at the Dublin market. This price differential varies considerably over time. The average differentials for each of the five years 1963 to 1967 were 43/9d., 25/-d., 21/-d., 32/-d., and 38/3d. per cwt., respectively. The average differential for the five year period was 32/- per cwt. If these statistical comparisons were valid, then it would appear that Irish farmers have a genuine grievance. The widening of the price gap in the latter half of 1966, associated with the depressed state of the market in that year, would seem to be evidence of the alleged weak selling. There were many abnormal factors operating at that time however.

The British beef and cattle market was under unusual pressure from supplies diverted from the self-sufficient E.E.C. market and from record home production; while demand was depressed by a tight credit situation, and reduced home consumption of beef. In addition, there was a U.K. shipping strike in May and June followed by a bank strike in this country.

Apart from the abnormality of the market in the second half of 1966, the comparability of the average price paid to U.K. farmers and the price of fat cattle at Dublin is questionable. The price of fat cattle in Dublin, although an aggregate of the prices of bullocks, heifers, bulls and cows in a single market only, is a reasonably accurate indicator of what factories pay for fat cattle destined for the British consumer (3). This price would have reflected the subsidy paid on all beef cattle slaughtered for the U.K. market in 1966 and the headage payment made on all live fat exports to the U.K. market during the period 31st August to 5th December of that year.

3. In 1966 the Dublin fat cattle price showed little or no variation from other published fat cattle prices, such as the price of 10-11 cwt. bullocks at Dublin store sales and 2-3 year-old cattle at fairs and marts.

On the other hand, the price paid to U.K. farmers for all cattle is an average over a large number of geographically dispersed markets and a wide range of cattle types. It encompasses, for example, the lighter, earlier finished home-breds and the heavier and older Irish reared, British finished cattle. The price to the British farmer also included the full Fatstock Guarantee Payment. It is unlikely, therefore, that these two prices are comparable.

Conceptually the differential between the price received by Irish producers for cattle slaughtered in Ireland for the U.K. market and the price received by British producers for home-finished animals can be divided into five components, as follows:

1. transport and handling costs including agents' margins;
2. processing and marketing cost differences between Ireland and Britain;
3. quality differences between Irish cattle killed in Ireland and in Britain;
4. quality differences between Irish cattle killed in Britain and British cattle; and
5. distributor or consumer prejudice.

Transport and handling costs for cattle between Ireland and Britain can be estimated fairly closely. This cost varies according to place of dispatch and final destination, but in 1966 it was between 15/- and 20/- per live cwt. (6). Likewise, in the case of carcase beef transport and handling costs vary according to destination and type of outlet. For example, a commission of 4.5 to 5.0 per cent. has to be paid on all beef sold at wholesale markets. Beef delivered direct to distributors probably incurs a higher delivery cost than that destined for wholesale markets. Consequently, the handling and transport costs (4) for carcase beef varies between 2d. and 4d. per pound deadweight. No such eivdence is available on processing and marketing costs, but it is reasonable to hypothesise that any difference that exists favours the Irish factories. The price differential between British fattened Irish bullocks and their home-bred counterparts at Edinburgh and Wooler is some indication of the importance of quality differences.

Since there were substantial differences between the prices paid for fattened home-bred and fattened Irish cattle at Edinburgh and Wooler, namely 17/6d. per cwt. and 2.8d. per lb., respectively, it appears that it would be more nearly comparing like with like if the Dublin fat cattle price was contrasted with the average price for fattened Irish stores in the U.K.

4. In addition to the actual transport cost, loss for shrinkage in transit, the cost of ice, muslin, insurance and possible commission are included.

The Real Price Gap

If it is assumed that the differences at Edinburgh and Wooler are representative of the British market as a whole, it is possible to calculate the "real" price gap between Ireland and the U.K. It is not certain that the two markets studied are representative of the overall U.K. market, but they are probably reasonably representative of those areas in the U.K. where Irish stores are fattened in appreciable numbers and this is the segment of the market relevant to the present discussion. The area serviced by the two centres studied takes about 20 per cent. of Irish store exports annually and there is no evidence to suggest that either Irish or British cattle in this area are atypical for the country as a whole.

The average price of fat cattle at Dublin in 1966 was 148/3d. per cwt. Average U.K. returns for fat cattle in the same year were 180/3d. per cwt. so that the apparent gap was 32/- per cwt. Assuming that the 17/6d. per cwt. differential at Edinburgh is representative of the national situation, the weighted average price of fattened Irish stores in the U.K. as a whole was 164/6d. in 1966 (5). Therefore, with these assumptions the "real" price gap in 1966 was not 32/- but only 16/3d. per cwt.

If it is further assumed that the 17/6d. price differential between British fattened Irish cattle and home-bred animals is constant from one year to the next, the "real" price gap for the period 1963-67 would also have been close to 16/- per cwt. on average. The data for each of the years are presented in Table 4. Since cattle prices and differentials fluctuate widely from year to year, this figure of 17/6d. is also likely to vary considerably. However, even if the figure was as much as 25 per cent. lower, the real gap would still only be 20/- which leaves little room for major inefficiencies.

The estimated real price differentials presented in Table 4 would be just about sufficient on average to cover marketing and transport costs, so that—in so far as the evidence goes—it does not suggest an unwarranted gap between prices of Irish fat cattle in Dublin and in Britain. Therefore, the price paid in Dublin appears to have been at a reasonable level.

The availability of suitable data makes deadweight price comparisons between Ireland and the U.K. even more hazardous than is the case for live cattle; nevertheless, some estimates are possible. Two major assumptions are necessary, firstly that the price paid for fattened Irish cattle slaughtered at Wooler is representative of the national situation for all fattened Irish cattle sold by deadweight; and secondly, that the

5. The weighting factor used was 10 per cent. on the assumption that Irish comprise 10 per cent. of total fatstock certifications. Even if the figure in any year was as high as 15 per cent. of total certifications, the effect on the estimated price of fattened Irish stores would be less than 1/- per cwt.

price quoted by Irish factories is a true representation of the returns to Irish farmers. The data for the carcase price comparisons are presented in Table 5.

Table 4
Estimated liveweight price gap for each year 1963-1967

	Average U.K. fat cattle price	Estimated price of British fattened Irish cattle in U.K.	Dublin fat cattle price	Apparent price gap (1)–(3)	Real price gap (2)–(3)
	(1)	(2)	(3)	(4)	(5)
1963	166/–	150/3	122/3	43/9	28/–
1964	173/9	158/–	148/9	25/–	9/3
1965	179/–	163/3	158/–	21/–	5/3
1966	180/3	164/6	148/3	32/–	16/3
1967	184/9	169/–	146/6	38/3	22/6

Table 5
Estimated deadweight price differential, 1966

	British fattened Irish (d/lb)	Price quoted by Irish factories (d/lb)	Price gap (d/lb) (1)–(2)
	(1)	(2)	(3)
January	34.4	30.7	3.6
February	34.8	31.8	3.0
March	35.3	32.3	3.0
April	36.8	34.7	2.1
May	36.5	34.5	2.0
June	37.3	35.0	2.3
July	37.0	32.1	4.9
August	34.5	28.7	5.8
September	33.1	26.5	6.6
October	32.0	26.1	5.9
November	30.3	26.0	4.3
December	32.8	26.6	6.2
Annual average	34.7	30.4	4.3

Note: The prices presented are for similar weight ranges and both include subsidy payments.

The price gap shown in Table 5, which averaged 4.3d. for the year, makes no allowance for transport and handling costs between Ireland and Britain. It has been estimated above that this cost varies between 2d. and 4d. per lb. deadweight depending on the destination of the meat and the type of outlet through which it is marketed. If it is average price gap net of transport costs is 1.3d. per lb. This gap of assumed that the average transport cost is 3d. per lb. the annual 1.3d. per lb. may be due to Irish killed beef selling at a discount in Britain relative to beef from fattened Irish cattle slaughtered in the U.K., or as a result of Irish factories being less efficient or making greater profits than their British counterparts. The price gap varies from one period of the year to the next, being greatest in autumn when prices are low, and least in spring the period of high prices. This indicates that factories practise price levelling, taking a loss or very much reduced profits when prices are high and greater than normal profits when prices are low.

If the comparisons made at Edinburgh reflect the situation at livestock marts in general and the Wooler comparison represents the picture for all factories, it appears that there is not as large a price gap between the price of fat cattle in Dublin and the U.K. as is often alleged. Nevertheless, the analysis presented is far from complete; for example, it could hardly be taken to represent Smithfield, where weak selling of Irish beef is frequently alleged and no doubt occurs on occasion. In addition, price parity with U.K. home production should not be accepted as the optimum situation. It may be possible to achieve a premium for Irish beef.

APPENDIX

Table 1

Average carcase weight in lb of home fattened Irish and of home-bred bullocks at Wooler, 1966

	Irish Wooler	Home-bred Wooler
January	671.5	531.4
February	665.5	523.8
March	677.6	586.8
April	639.6	593.8
May	703.2	591.3
June	641.5	539.4
July	664.3	567.2
August	653.6	554.7
September	680.1	570.8
October	656.5	553.9
November	748.1	563.2
December	715.0	637.6
Annual average	677.0	567.0

Table 2
Price in pence per lb of fat cattle at Wooler, 1966

	Home-bred	British fattened Irish	Price Difference
January	35.7	33.7	2.0
February	36.5	34.0	2.5
March	36.0	34.8	1.2
April	37.7	36.6	1.1
May	36.8	35.7	1.1
June	38.9	37.4	1.5
July	38.6	36.4	2.2
August	36.2	34.1	2.1
September	35.3	32.2	3.1
October	32.7	30.6	2.1
November	33.3	29.3	4.0
December	32.9	31.1	1.8
Annual weighted average	36.3	33.5	2.8

Table 3
Average price and distribution of cattle by weight at Wooler, 1966

	Price (d/lb)	Home-bred (%)	British fattened Irish (%)
<525 lb	36.8	30.2	0.7
525–645 lb	35.7	55.1	30.3
>645 lb	33.2	14.7	69.0
		100.0	100.0

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The Availability of Dairy By-Products for Feeding to Farm Animals

by

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Introduction
It is unnecessary to stress the importance of the Irish Livestock industry to the national economy, particularly in the light of recent developments in price supports for agriculture. Because of the importance of the livestock industry it is essential to avoid, as far as possible, anything which will seriously upset it. This on the other hand must be balanced as far as possible with the necessity to develop an efficient and progressive dairy products industry. It is, in a large measure, through the development and maintainence of a highly successful dairy products industry that the dairy farmer is guaranteed his income and will continue to make available the large numbers of calves required for the livestock trade.

To operate a successful dairy products industry, both in terms of internal efficiency and in the context of exporting a substantial volume of its products, requires as great a range of products as possible. This involves the utilisation of a substantial amount of skim milk both in whole milk and skim milk products. From the point of view of establishing and retaining Ireland as a force in international dairy product markets it is important that all major products, at least, be manufactured and sold even when the return is not so satisfactory.

Skim Availability
In recent years this has led to an extension in the manufacture of cheese, skim milk powder and chocolate crumb with the result that a smaller proportion of skim than heretofore has been returned to farms. Even with the frequently-quoted "skim milk powder crisis" the total proportion of skim returned to farms in 1968 as compared with 1967 was only marginally higher up to mid-October. This of course is taking skim returned to farms as a percentage of total intake of whole milk. The relevant figures were 43.6 per cent. in 1968 and 41.6 per cent. in 1967. When total quantities are taken into account the figures are quite different because of the significant increase in intake in 1968. Up to

mid-October this year 183.5 million gallons of skim were returned compared with 159.2 million gallons in the same period in 1967.

If the same rate of return to farms continues up to the end of March (i.e. the end of the 1968 milk year) then it seems that a total of approximately 225 million gallons of skim will have been made available for on-farm feeding of livestock. This compares with approximately 190 million gallons in both 1966 and 1967. One of the problems, however, is to establish precisely what the demand is for skim at farm level. Essentially the determining factor is the price at which skim can be sold to the local creamery but it would appear that there are other factors involved. Included in these no doubt is the question of the convenience of selling all the milk to the creamery, particularly if can washing facilities are available. I will refer more specifically later on to the question of the demand for skim but it is sufficient at this stage to point out that the level is far from clear and perhaps not in any way constant.

Location of Skim Supply

Information on the exact amount of skim returned to farmers in any given year is not readily available for each creamery area or even each county. It seems, however, that, if the suggested figure of 225 million gallons is returned to farmers in the 1968 milk season, it will be distributed throughout the provinces roughly as follows:

Munster	150 m. gallons
Leinster	32 m. gallons
Connaught	32 m. gallons
Ulster	11 m. gallons
	225 m. gallons

This distribution is based on the experience up to mid-October. In the case of Munster, it is reasonable to assume that very little skim was returned to farmers in the areas served by Ballyclough, Mitchelstown and Waterford co-operatives. It is equally likely that the percentage returned to farmers in the area served by the member creameries of the Golden Vale federation was not particularly high either. As a result the total skim returned to farmers in other Munster areas must have been considerably higher than the average for Munster as a whole. It is worth pointing out, in passing, that in the three Ulster counties the quantity of skim returned to farmers as a percentage of total intake is lower than in any of the other provinces. Furthermore the average price received by producers for their skim has, throughout 1968, been considerably higher in the three Ulster counties than in any other province.

Demand for Skim

As mentioned earlier it is extremely difficult to estimate precisely what the demand is for skim for animal feeding. In 1967 in a document prepared by the Department of Agriculture for the N.A.C. it was assumed that it would be very difficult to convince farmers to use a greater quantity than was then being used, i.e. 190 million gallons per annum. In fact this document pointed out that in 1967 farmers would probably not have utilised that much if all creameries were able to obtain a market for the skim. The Department considered at that stage that the quantity of skim being returned was adequate to meet the existing demand. This, however, was before the real selling crisis for skim milk powder became effective. The price available for skim milk as a result was at least 1d. per gallon higher on average, than it is now or even was throughout most of the year.

In a further document prepared by the Department of Agriculture in May 1968 when the price available for skim powder and as a result skim milk, had dropped considerably, a different point of view is stressed. This document sets out to show desirable levels of feeding to calves, pigs and sows at differing values for skim. These levels of feeding are then applied to the existing livestock numbers in each county and as a result a theoretical demand is calculated for the different value levels of skim milk. For example:

If the value is 0d. then the demand should be 919.5 m. gallons.

If the value is 3d. then the demand should be 687.4 m. gallons.

If the value is 6d. then the demand should be 208.3 m. gallons.

Even at the very high value of 6d. per gallon it would appear that the livestock industry could profitably absorb almost the total quantity presently being returned to farms. On the other hand if the price is 3d. per gallon (perhaps a more realistic price in the light of present circumstances) the effective demand should be almost three times the amount available.

This exercise in theoretical demand is furthermore shown for each county with the result that if the value placed on skim milk is 3d. per gallon then the demand from each province would be as follows:

Munster	314.0 m. gallons
Leinster	198.4 m. gallons
Connaught	99.2 m. gallons
Ulster	77.5 m. gallons

It must be emphasised that these are what are termed desirable levels of feeding at a given value of 3d. per gallon. They are not by any means effective levels of feeding which would arise even if skim was available. These figures compare with actual availability in the 1968 milk season as indicated already, of Munster 150 million gallons, Leinster and Connaught 32 million gallons each and Ulster 11 million gallons.

Prospects for Skim

In giving any assessment of the likely development in skim one is automatically entering the realm of prophesy because forecasting ahead the likely development in the market for skim milk products is not easy in itself. Coupled with this is the necessity to forecast the likely development in milk supply. This latter point in itself is not particularly difficult if we are talking about a relatively short-term projection because it now seems certain that milk supplies in the 1970 milk season will be considerably in excess of the 550 million gallons forecast and may even exceed the 600 million gallons. On the other hand the recent statement from the Minister for Agriculture on the future of the Irish Dairy Industry suggested that there may have to be some tapering off in the rate of increase. If total creamery milk production increases to a figure of approximately 600 million gallons and if the value of skim return was to be maintained then the total level available for on-farm feed in 1970 would be in the region of 260 million gallons. This is also on the assumption that price levels for skim products do not change significantly in the period and also on the assumption that farmers are prepared to utilise this quantity of skim milk.

The situation with regard to international markets for skim products is much more complex but it does seem likely that in the next two years the situation will not have improved significantly but is equally not likely to have deteriorated any further. In this context it must be mentioned that there is every possiblity that the Irish Dairy industry will become involved in the manufacture of Casein on a reasonably large scale but it seems that it is likely to be at the expense of skim milk which is currently being made available for skim milk powder.

Whey Supplies

The question of the availability of Whey for pig feeding has within the past year aroused a considerable amount of controversy largely because of the intention of most of the cheese manufacturers to erect a factory for the manufacture of Lactose. Such a factory to be economic would require about 40 million gallons of Whey per annum. Estimates which have been prepared by the manufacturers suggest that there is at least this quantity of Whey available or likely to be available when the factory is erected over and above the existing requirements of pig feeders. This quantity would arise at the following points:

Wexford	4.0 million
Kilmeaden	3.0 million
Rathduff	5.0 million
Avongate (Ballyragget)	3.5 million
Listowel	3.0 million
Landsdowne	4.5 million
Newcastlewest	4.5 million
Golden Vale Group	6.6 million
Tipperary (proposed)	5.0 million

At an early stage in the discussions on the establishment of a Lactose factory cheese manufacturers met representatives of the pig fattening co-operatives and discussed with them their requirements. One of the difficulties envisaged was that although the pig fattening co-operatives and others could easily have absorbed a considerable amount of this surplus 40 million gallons it was not clear at what price they would be prepared to purchase the Whey. Estimates of the likely return to the cheese factory suggested that a Lactose factory would yield about 1d. per gallon and most of the pig fattening co-operatives would not have been prepared to buy Whey ex-factory at this price. In the present circumstances without a Lactose factory Whey is readily available and is being sold at a figure considerably lower than this.

In 1967 it is estimated that the total volume of milk utilised in cheese making in Ireland was in the region of 55 million gallons. This would suggest that the total Whey resulting from cheese making was approximately 49 million gallons. In the figures given already in regard to the availability of Whey for a Lactose project 15 million gallons is in respect of factories which are not, or were not in production in 1967. As a result the existing factories are indicating an availability of 25 million gallons. It would seem, therefore, that a further 24 million gallons of Whey from the already existing factories had been earmarked for pig feeding. Estimates of milk usage for cheese manufacture in 1970 suggest that 65 million gallons will be used and this would indicate that the total amount of Whey available from this would be 58.5 million gallons. On this basis it would seem that the amount of Whey being made available for feeding after the erection of a Lactose factory in 1970 would only be slightly smaller at 18.5 million gallons than the existing figure of 24 million gallons which seems to have been utilised in 1967. There is no definite information available with regard to Whey usage in 1968 but it seems certain that a substantial amount of it was dumped or disposed of in some way other than pig feeding. This has probably arisen largely from the fact that the skim milk powder crisis made more skim milk available but it also arose from the fact that many of the pig feeding areas in the country would find it too expensive to transport Whey from the existing available source.

In the light of current difficulties with regard to cheese making it is unlikely that total cheese production in 1970 and subsequent years will require very much more than the 65 million gallons already indicated. As a result there seems little liklihood of any great increase in the total quantity of Whey available for feed unless the plans for the Lactose factory are not implemented. There is one further source of Whey, however, which may well arise in the near future and this concerns the Whey resulting from the manufacture of Casein. Since any new Casein development in this country is likely to be one involving the use of hydrochloric acid there is still some doubt as to whether the resultant Whey will be suitable for feeding to animals without further treatment.

Summary

One of the major problems with regard to the availability of dairy by-products for animal feed is that the greatest proportion of these dairy by-products arise in the southern half of the country whereas the demand exists in most parts of the country. In particular there seems to be a considerable discrepency between available supplies in Leinster and the potential demand in that province. This applies equally to the counties of Cavan and Monaghan where an extremely high percentage of the total skim resulting at the creameries is utilised in the manufacture of skim milk products. On the other hand both of these counties have a high incidence of calf and pig feeding. Whether or not there is a long-term future in the feeding of milk substitutes to farm animals is not yet clear but in areas where a successful industry has been established and utilising skim milk farmers have made considerable use of these products and apparently have suffered no financial disadvantage. The important factor however is that they are able to dispose of their skim milk at what would be termed "a good price".

The future is particularly difficult to predict because very much depends on the price available for skim milk products and indeed whole milk both on international markets, on the structural re-organisation which could occur in the industry and on the value which farmers place on the convenience of having their cans washed at the creamery premises and returned empty.

The Replacement Heifer – Rear or Buy?

by

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Introduction

The provision of young cows is an important component of the dairy enterprise not only in relation to replacement *per se* but also for expansion. Presently about 300,000 young cows are entering the national herd each year (Table 1) but the actual percentage is dependant upon

Table 1
Disposal of Cows and Culling Rates in National Cow Herd 1957 '68

Year	No. of cows on farms June 1st	Net disposal (a) of cows	Culling Rate
	('000)	('000)	%
1957	1,235.7	205.1	16.6
1958	1,260.4	205.7	16.3
1959	1,272.0	265.6	20.9
1960	1,283.7	247.3	19.3
1961	1,290.5	214.4	16.6
1962	1,309.3	256.6	19.6
1963	1,322.5	221.8	16.8
1964	1,399.9	171.0	12.2
1965	1,547.4	230.0	14.9
1966	1,582.3	301.9	19.1
1967	1,569.9	323.6	20.6
1968	1,602.9	290.5	18.1

Source: 1957–1965 Farm Bulletin, July, 1966. 1966–1968 Author's estimate.
a. Slaughtering at export premises + estimated home consumption + estimated mortality + (live exports—live imports).

whether the industry is in a dynamic or stationary phase. In practice, rearing heifers can be viewed as a separate enterprise on a farm or a separate farm system which supplies replacers to the market. In this situation where heifers are reared in conjunction with the dairy enterprise (and this is, by far, the more common) their contribution to total gross margin per unit of land is usually unsatisfactory by comparison with the major enterprise on the farm. This comment is prompted by some experience in examining farm account data. It must be recognised, however, that the capital investment per livestock unit for milking facilities together with the labour requirement for this type of livestock are somewhat less than for dairy cows.

Methodology

In this exercise we are assuming that a replacement animal can be calved at 2 years of age in early March. The desirability of early rather than later calving can be illustrated by the fact that once feed becomes restrictive towards the end of the grazing season milk yields irrespective of stage of lactation will be severely affected. Furthermore, it has been demonstrated by Mr. Gleeson at Moorepark that the cost of boosting yields by supplementary meal feeding towards the latter end of the lactation is about twice as expensive as at the beginning.

Setting the problem in the context of a farming system will render the exercise more meaningful and it resolves itself into one of buying in young Friesian heifer calves in March and selling the surviving animals as in-calf heifers 2 years later. This involves synthesizing and incorporating into the system the various components involved in the process and the costs of rearing replacements from birth to first calving. As cattle prices are notorious for their variability it will be necessary to take cognisance of this factor. Accordingly three different purchase and sale price combinations are used. For each stage of the process an attempt is made to minimise costs for a particular addition to output (i.e. weight). In effect growth should be accelerated as far as possible when feed costs are cheap (e.g. summer).

The physical data for this exercise is derived from appropriate experiments in both Moorepark and Grange. Although it is difficult to define an "optimum" for each stage from inter-experiment comparisons, nevertheless it is possible to make recommendations from these which are quite acceptable in the sense that the response anticipated should be attainable with a reasonable degree of confidence.

Starting then in March by purchasing young calves of about 90 lb. weight we employed the physical and financial data as set out hereunder.

PHYSICAL AND FINANCIAL DATA EMPLOYED IN EXERCISE

(a) *Physical*

(i) average daily gain		lbs
0 through 7 months	... ...	1.25
8 through 9 months	... ...	1.00
10 through 12 months	... ...	1.20
13 through 21 months	... ...	1.50
22 through 24 months	... ...	1.00
initial weight	... ...	90
final weight	... ...	1,000

(ii) Feeding regime		
0 through 3 months	... ...	pasture + milk substitute [to 7 weeks] + meals
4 through 7 months	... ...	pasture
8 through 9 months	... ...	pasture + meals (2 lbs/day)
10 through 12 months	... ...	silage + meals (3 lbs/day)
13 through 21 months	... ...	pasture
22 through 24 months	... ...	silage + meals (2 lbs/day)

(iii) conception rate 90%

(iv) mortality rates (calves 5%, 10%)

(v) stocking rate 1.25 acs/L.U.

(b) *Financial*

		£	
(i) calf prices	20,	15,	10
(ii) in-calf heifer prices ...	90,	80,	70

Results

As mentioned previously the problem is set in a farm system context. Hence we will estimate output, costs, and gross margins for a 75 acre farm with one permanent labour unit. It is also assumed that silage is made on contract at a cost of 10/- per ton. The distribution of variable costs is given in Table 2.

Output, variable costs, and gross margins per acre for each price combination are given in Table 3 for the low level of calf mortality.

Table 2
Distribution of Variable Costs (a)

Item	per ac. (£)	Total (£)	% of Total
Concentrates	11.1	830	50.4
Vet. and Med.	2.7	201	12.2
Hire	2.3	170	10.3
Fertiliser	4.6	345	21.0
Labour		40	2.4
Misc.	1.3	60	3.7
Total	22.0	1,646	100.0

a. Approximately *60 percent of these costs are accumulated by the animal by the end of its first year.*

Table 3
Output, Variable Costs, and Gross Margins per acre (a)

Calf prices (£)		Heifer prices (£)		
		90	80	70
20	Output	54	47	40
	Var. costs	22	22	22
	Gross margin	32	25	18
15	Output	58	51	44
	Var. costs	22	22	22
	Gross margin	36	29	22
10	Output	62	55	48
	Var. costs	22	22	22
	Gross margin	40	33	26

a. At the 5% mortality level.

Comments

The gross margin per acre in Table 3 varies from £40 to £18 depending upon which price combination is used. The former figure would be achieved with calves purchased at 1967 prices and sold at 1969 prices. Of course we must remember that when calf prices are low heifer prices also tend to be low but the percentage *variation* for calves is usually much greater than for heifers. However, if we adopt a figure of £30 or so as being a reasonable indicator of the gross margin from this enterprise one might expect a gross margin in the region of £50 per acre for the dairy enterprise with a comparable level of efficiency.

In effect, then, it would cost a farmer about £20 per acre for each acre he had devoted to the replacement enterprise, or alternately his total gross margin would be reduced by this amount for each acre. Against this must be set the risk involved in purchasing in-calf heifers with its' attendant problem of introducing disease into a dairy herd. However, when it is clearly pointed out to a farmer what it is costing him to rear his own replacements, it will make his decision-making problem less difficult.

The Use of Dairy By-Products in Pig Feeding

by

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The dairy by-products available to the pig industry are skim milk, buttermilk and whey. In terms of the nutrients they supply, these by-products may be treated under two headings, (A) protein sources (skim milk and buttermilk), (B) energy sources (whey or all three depending on the level at which they are fed). The approximate quantities available nationally for pig feeding are as follows, skim milk, 85 million gal.; buttermilk. 18 million gal.; whey, 50 million gal. (1). In terms of meal the combined quantities of skim milk and buttermilk are equivalent to 57,500 tons of balanced pig feed, while whey is equivalent to a further 16,750 tons of barley.

Production of dairy products is seasonal and consequently the availability of skim milk and whey varies from a situation of too much at some stages of the year to too little at others. The over plentiful supply of these by-products during the summer months lowers their economic value to such an extent that they are a much cheaper source of pig feed than conventional feedstuffs. Pig farmers are therefore often faced with the problem of forcing the pig to drink larger quantities of skim and whey than required for efficient utilization or optimum production by the pig.

Dairy by-products can form a very valuable portion of the pigs diet provided certain precautions are taken both with regard to the feeding system and general hygiene. Milk products should always be introduced gradually to the pigs diet, especially, where pigs have been fed for a period on cereal based diets. This adaption period is necessary because the activity of the enzyme lactase, responsible for the degradation of lactose, decreases when pigs are weaned from a milk based diet and consequently, milk products will be inefficiently utilized until such time as the activity of this enzyme increases.

Milk products are an excellent media for the growth of moulds, yeasts and bacteria. When this is combined with the high temperatures that exist in many piggeries, then the importance of hygiene where dairy by-products are fed becomes very evident. Failure to observe caution with regard to either of these points is hazardous, as it can only lead to poor performance and increased mortality in pigs.

Skim Milk as a food for pigs

Skim milk (skim) is a very good source of nutrients for pigs. It can be fed to pigs of all ages but is particularly useful for growing pigs because of their high protein requirement.

While skim is highly nutritious an examination of Table 1 shows that it is not a completely balanced feed for pigs. The total solids content is low and if given nothing but skim, pigs daily nutrient intake would be marginal. Skim is devoid of vitamins A and D which are removed with the milk fat, but is a good source of the water soluble B vitamins. Calcium and phosphorus are present just in sufficient quantities to balance the dry matter of skim, while minerals such as iron, zinc, manganese and copper are present in very minute quantities. The crude protein content of skim is high and is also very digestible. This protein is high in lysine and other essential amino acids thus making skim an excellent protein source for pigs.

To get best utilization of skim it must be fed in conjunction with barley (or some other cereal) to which supplements are added (Table 2). Where properly supplemented, each gal. of skim can be equated to 1.25 lb. of a balanced diet. In terms of its protein content each gal. is equivalent to 0.5 lb. of fish meal or 0.75 lb. of soyabean meal while the actual protein has a higher biological value.

Feeding skim to growing-finishing pigs

There are essentially two situations encountered when feeding skim to pigs, (1) The supply of skim is limited and it is used to supply the protein portion of the diet.

(2) The supply of skim is unlimited and it is used to supply both protein and energy to the diet.

Situation (1) results in the most efficient utilization of skim and is more desirable nationally.

Skim, even in small quantities, over-supplies the protein requirement of the pig while the energy requirement is under-supplied. This has led to the traditional system of feeding skim in limited quantities to meet the protein requirement, the energy being supplied by a cereal. This system allows a maximum of 6 pints of skim daily, the remainder of the diet consisting of cereal. Recent research (3) indicates that there are advantages to be obtained from feeding higher levels of skim as outlined in Table 3. This higher level will result in leaner carcasses with consequent improved grading provided allowance is made for the extra skim by reducing the meal allowance proportionally. When feeding skim in limited quantities it is best given at one feed as this ensures each pig getting its quota.

Table 1
Average composition of skim milk
(Lyons and O'Shea)

Ingredient	Percent
Total solids	9.39
Crude Protein	3.54
Lactose	4.88
Fat	0.03
Calcium	0.08
Phosphorus	0.06
Trace minerals	—
Vit. A & D	—
Vit. B complex	+
Other constituents	0.60

Table 2
Supplements to be added per ton of cereal when feeding skim to:

	growing pigs	sows
Limestone flour	20 lb	20 lb.
Dicalcium phosphate	10 lb	10 lb
Iodized salt	5 lb	5 lb
*Copper sulphate	1 oz	1 oz
*Ferrous sulphate	4 oz	4 oz
*Zinc carbonate	8 oz	8 oz
*Manganese sulphate	8 oz	8 oz
Vit. A	3 m.i.u.	9 m.i.u.
Vit. D_3	0.8 m.i.u.	0.8 m.i.u.

*These trace minerals are added as an insurance against possible deficiencies.

Table 3
Meal and skim scale for pigs from 40 to 200 lb liveweight

Liveweight (lb)	Meal (lb)	Skim (pints)
40	1	5
90	2¼	10
120	3¼	10
200	5	10

When skim is plentiful and competing economically with cereals as a source of energy, a different feeding system becomes desirable. In this situation it is important to have pigs consuming the maximum amount daily, without unduly affecting performance. However, at very high intake, skim is not efficiently utilized and its replacement value drops to 1.1 lb. of meal per gal. (4).

Skim has been fed as the sole source of feed for pigs (5) but this system is prone to digestive upsets and consequently, may be accompanied by poorer performance. Better results are obtained where part of the diet consists of meals as this restricts skim intake and reduces the incidence of digestive upsets. Therefore, even where skim is plentiful, the best system to adopt is to feed 2 lb. of cereal per pig daily plus skim ad libitum. The cereal may be given at a single feed either in the morning or evening and to ensure maximum intake of skim water should not be available. The peak daily consumption of skim using this feeding system would be 3 to 3.5 gal. per pig.

There is very little difference between the two systems outlined for feeding skim, in terms of pig performance. The system to choose depends entirely on the relative costs of skim and other feeds. Table 4 shows the results of an experiment comparing both systems.

Table 4
Restricted versus ad libitum skim feeding
(Mitchell and Sedgwick, 1960)

		Restricted	Ad. lib
Max. feed intake at 200 lb	Meal (lb)	5.30	2.00
	Skim (pints)	5.25	34.00
Daily gain	(lb)	1.39	1.44
Feed/pound liveweight gain	Meal (lb)	2.80	1.41
	Skim (pints)	4.40	17.10
Meal + 88 % D.M. skim	(lb)	3.28	3.30

Effect of feeding skim on carcass quality

Theoretically, diets containing a high proportion of skim should produce leaner carcasses because of the high protein intake, which is also high in lysine. If however, allowance is not made for the energy content then fatter carcasses may result on feeding skim, simply due to increased energy intake. For each extra pint of skim fed, the meal allowance should be reduced by 2.5 oz. If this is done, then increasing the skim content of the diet will result in leaner carcasses (3). Where skim is being fed in limited quantities care must be taken to ensure that all pigs get their quota, otherwise pigs may become overfat due to insufficient protein intake.

Feeding skim milk to sows

With regard to the gestating sow, the present practice is to feed her 4.5 lb. of a balanced diet daily. The same nutrients can also be provided by 1 gal. of skim plus 3.4 lb. of a cereal, supplemented as shown in Table 2. Where skim is readily available larger quantities may be fed. Four gallons of skim would supply the protein and energy needs of the sow but certain minerals and vitamins would be deficient. There is also the possibility of digestive upsets on a complete milk diet. Therefore, part of a gestating sow's diet should consist of cereal (1 to 2 lb. daily).

In the case of lactating sows (rearing 9 piglets) an average daily feed intake is 13 lb. of a balanced diet. If skim were used to supply the protein requirement, the daily feed allowance would be 3 gal. of skim plus 10 lb. of cereal. Larger quantities of skim could be fed to meet some of the energy requirement, but for the lactating sow the energy requirement is high and cannot be met entirely by skim. The maximum daily intake of liquid by a sow is in the region of 6 gal., which in terms of skim represents 7.5 lb. of a balanced diet. Where skim is plentiful the lactating sow should get a minimum of 7 lb. of cereal daily, plus skim ad libitum.

A problem often encountered when feeding skim to lactating sows is that young piglets may also drink from the sows trough. This need not be a problem if troughs and the area around them are kept clean and skim may, in fact, form part of the suckling pigs diet. If hygiene is poor then mould and bacterial growths may develop which if ingested could cause digestive upsets.

Should skim be fed sour or sweet?

Feeding skim in either the sour or sweet state does not seem to have any significant effect on pig performance. However, it is important to feed consistently in one or other state. If skim of variable sourness is fed, then digestive upsets develop. For very young pigs sweet skim is more desirable because of its palatability.

If skim is being fed sour, then a two-day period should be allowed between separation and feeding for souring to be completed. Where skim is being fed sweet, it should be used on the day it is separated. If this is not possible, skim can be prevented from souring by the addition of 0.15 per cent. formalin (1.5 lb./100 gal. milk). Under normal conditions, treated skim will remain sweet for approximately 8 days. (6 days during very warm weather). Formalin treated skim may be slightly less palatible than untreated skim but it has the advantage that it can be fed through drinking bowls and nipples.

Economics of feeding skim

Skim may replace the protein or both the protein and energy fractions of the pigs diet depending on the quantity fed. Consequently its economic value depends on the quantity fed.

Where quantities of not greater than 1 gal. of skim are fed daily then this gal. may be equated to 0.43 lb. of soyabean meal plus 0.82 lb. of barley. At current prices for these ingredients this represents a value of 5d. per gal. Where intake is greater than 1 gal. per day, skim replaces barley in the diet and is worth approximately 3.7d. per gal.

These calculations give an indication of the economic value of skim. They do not however take into account the higher biological value of skim protein, neither do they account for the cost involved in transport, handling and maintaining hygiene where skim is fed.

Buttermilk as a food for pigs

Buttermilk has practically the same composition (Table 5) as skim and may be treated as such when being fed to pigs. Economically it has the same value as skim.

Table 5
Average composition of buttermilk
(Lyons and O'Shea)

Ingredient	Percent
Total solids	9.87
Crude protein	3.52
Lactose	4.86
Fat	0.50
Calcium	0.08
Phosphorus	0.06
Trace minerals	—
Vit. A and D	—
Vit. B complex	+
Other constituents	0.85

Whey as a food for pigs

Whey may be used successfully as a feed for pigs provided its deficiencies are recognised and supplemented adequately. It gives best performance when fed in limited quantities and can form part of the diet for pigs of all ages.

The composition of whey shown in Table 6 reveals some of the deficiencies. Total solids content is very low and pigs could not possibly consume enough whey daily, to meet their nutrient requirements. Approximately 75 per cent. of the whey dry matter consists of lactose, consequently, whey must be introduced gradually to the diet of mature pigs that have been fed for a period on cereal based diets. The crude protein content of whey is low but the amount present is very digestible. Whey is a good source of B vitamins but does not contain vitamins A or D. Calcium and phosphorus are present in a concentration sufficient to meet the pigs requirements but insufficient to make whey a source of these minerals. Iron, zinc, manganese and copper are present in trace amounts and may in cases be deficient. The concentration of soluble chloride salts varies with the manufacturing process but should not be a problem even where large quantities of whey are fed.

While the total solids content of whey is low, if it is properly supplemented, each gal. of whey may be equated to 0.75 lb. of barley.

Table 6
Average composition of whey
(Lyons and O'Shea)

Ingredient	Percent
Total solids	6.64
Crude protein	0.62
Lactose	4.96
Fat	0.30
Calcium	0.06
Phosphorus	0.05
Trace minerals	—
Vit. A and D	—
Vit. B complex	+
Other constituents	0.65

Feeding whey to growing-finishing pigs

Whey can be fed in varying amounts to pigs but best results in terms of whey utilization are obtained when it is fed in limited quantities. Where limited feeding is practiced, whey is gradually introduced to the pigs diet (each gallon replacing 0.75 lb. of barley), to a maximum of 2 gal. daily at 100 lb. liveweight. At this stage the whey allowance is fixed and thereafter the meal allowance is increased. Daily meal and whey allowances per pig for this feeding system are given in Table 7 and the composition of the meal (whey supplement) is given in Table 8. This feeding system gives very good results in terms of daily gain and feed efficiency as shown in Table 9.

Table 7
Daily allowances of meal and whey from 40 to 200 lb

Liveweight (lb)	Meal (lb)	Whey (gal.)
40	1.5	0.5
80	2.5	1.5
100	3	2
140	4	2
200	5	2

Table 8
Composition of whey supplement for:

	growing pigs	lactating sows
Barley	16 cwt	17 cwt
Soyabean	4 cwt	3 cwt
Limestone flour	20 lb	20 lb
Dicalcium phosphate	10 lb	10 lb
Copper sulphate	1 oz	1 oz
Ferrous sulphate	4 oz	4 oz
Zinc carbonate	8 oz	8 oz
Manganese sulphate	8 oz	8 oz
Vit. A	3 m.i.u.	9 m.i.u.
Vit. D_3	0.75 m.i.u.	0.75 m.i.u.

Table 9
Performance of pigs on restricted whey intake
(O'Grady, 1963)

Max. feed consumed per day		Daily gain	Feed efficiency
Meal (lb)	Whey (gal.)	(50–200 lb liveweight)	(Meal+87% D.M. whey)
6.61	—	1.58	3.37
5.73	1	1.70	3.32
5.40	1.5	1.67	3.18
5.07	2	1.67	3.07

In situations where whey is plentiful, quantities greater than two gallons may be fed. The system of feeding in such a situation is one that ensures high intakes of whey and at the same time does not unduly reduce pig performance. The amount of whey consumed by pigs can be increased by reducing the quantity of meal fed (Table 10). However, as the quantity of meal fed decreases the performance of pigs decreases such that even where large quantities of whey are available, it is not practical to feed less than 2.5 lb. of meal per pig daily. If whey is fed ad libitum with this allowance of meal, pigs will consume 4 to 5 gal. daily in the final stages of fattening. Daily liveweight gain will be reduced somewhat, as compared to an all meal diet, such that days to slaughter (50 to 200 lb. liveweight) will be increased by approximately 15 days (7).

Table 10

Effect of varying levels of meal on daily whey consumption*

(Mitchell and Sedgwick, 1963)

Approx. age of pigs wks.	3 lb meal daily decreasing to 2 lb at 13 weeks		3 lb meal daily		2½ lb meal daily		3 lb meal daily decreasing to 2 lb at 13 weeks increasing to 2½ lb at 20 weeks	
	Meal (lb)	Whey (gal.)	Meal (lb)	Whey (gal.)	Meal (lb)	Whey (gal.)	Meal (lb)	Whey (gal.)
9	3	0.6	3	0.7	2.5	0.7	3	0.7
14	2	2.1	3	1.6	2.5	2.0	2	1.9
19	2	3.8	3	2.5	2.5	3.2	2	3.6
24	2	4.9	3	3.3	2.5	4.3	2.5	4.4

*Water was not available

Feeding whey to sows

Whey may be included as part of the diet for gestating sows. However, it is not possible to feed these sows entirely on whey, as nutrient intake would be insufficient. The system of feeding should include a minimum of meal equivalent against a requirement of approximately 13 lb. A meal are fed, then whey should be restricted and fed on the basis of one gal. being equivalent to 0.75 lb. of barley. The whey supplement outlined on Table 8 may be used for gestating sows.

With regard to lactating sows, whey can form only a small part of the total diet. A sow consuming 6 gal. per day would be getting 4.5 lb. of meal equivalent against a requirement o fapproximately 13 lb. A suitable feeding system for lactating sows is, 9 lb. of meal (Table 8) daily plus whey ad libitum.

Storage of whey

Untreated whey cannot be stored for long periods and yet maintain its feeding value. After 2 to 3 days in storage, yeast, mould and bacteria counts increase and cause deterioration by converting lactose to lactic acid. Formalin added at the rate of 1.5 lb. per 100 gal. slows this deterioration somewhat, but even then storage beyond 3 to 4 days is not recommended.

Due to the seasonality of whey there has been quite a lot of interest recently in storing whey during the summer months for feeding during the autumn and winter months. Two approaches to the problem have been studied at Moorepark and are summarized as follows:

1. Lagoon storage of whey—this is a simple and cheap method for storing whey but is very inefficient in the preservation of nutrients. Moorepark results suggest that after 10 days storage whey has lost at least 50 per cent. of its feeding value. (8)

2. Lagoon storage of condensed whey—with this method whey is first concentrated to 20 per cent. total solids and then stored in a lagoon. Whey maintains its chemical composition for up to 3 months under this system of storage. (9)

Economics of feeding whey

Whey substitutes for the cereal portion of the pigs diet, hence its economic value may be compared to that of barley. One gal. of whey supplies the same nutrients as 0.75 lb. of barley and this substitution rate holds even where large quantities of whey are fed. In situations where whey intake is limited (2 gal./day and less), the substitution rate may be higher. Therefore, costing barley at £31 per ton, whey is worth approximately 2d. per gal. In practice however, whey is not worth this price for a number of reasons.

Transportation of whey is costly, as is the handling of whey on the farm, where it increases the labour requirement of feeding. Glazed tile troughs are essential since whey is corrosive and pen floors also deteriorate faster where whey feeding is practiced. The overall performance of pigs decreases when large quantities of whey are fed and the incidence of digestive upsets increases. Considering all these points, it is difficult to put a single price on the value of whey. It depends on: haulage distance, feeding system, quantity fed and most important, the price of other feeds.

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Problems of Animal Health in Relation to Intensive Grassland

by

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It is well known that there are a variety of diseases and disorders which are confined to grazing animals, and the occurrence of which is related to the pasture. As the system of grazing changes from an extensive range-type pasture to an intensive production enterprise, there is a concurrent change in the disease pattern. Obviously there are problems of management in intensive grassland, and one has to appreciate at least some of these in order to understand many of the diseases which assume increased importance. From the point of view of this paper, probably the most relevant problem is the maintenance of a food supply with something approaching a constant nutritional value.

By now, I imagine, all are familiar with the pattern of seasonal variation of quality in a grass pasture. During the early part of the year the grass is growing quickly, in the leafy stage, and supplies a highly digestible product, rich in soluble carbohydrates and protein. However, by the latter part of July the feeding value of the grass falls off and, almost in spite of any variation in management, from there on through the autumn it is a product of moderate value. The addition of clover to this pasture will alter the pattern considerably, giving a food in July and August of a higher value to the ruminant than grass of the same period. It is not for me to discuss the problems of managing a grass/clover sward, nor to theorise on the possibility of grass supplies for the early season and of clover for later on, but it is my purpose to look at some of the health implications of these nutritional changes. For instance, a few years ago we undertook an experiment on a cobalt-deficient pasture and compared the growth rates of two groups of lambs of varying age (1). The first group were born in mid February and were slaughtered in June; the response to cobalt was about 4 lbs. per lamb. The second group were born early in April and were run on the same pasture; by mid July there was a clear effect in favour of cobalt in this group, and within the next few weeks many of the undosed lambs were losing weight, whereas the cobalt-supplemented lambs continued to thrive satisfactorily. By the end of August there was a difference of 17 lbs. between the average weights of the treated and control lambs in this group.

This difference in performance may have been caused by one or more of several factors—but important amongst these, I am sure, was the quality of the herbage. Cobalt deficiency, in the degree which we commonly see it, affects the value of the food to the ruminant—a reduction in the quality of a pasture as measured in the laboratory will affect the cobalt deficient lamb much more seriously than the lamb which has an adequate supply of cobalt. In addition the length of time that the lambs were exposed to the low cobalt diet would be important; as the rate of gain for cobalt supplemented lambs was a ½ lb. per day in the first experiment and a ⅓ lb. per day in the second experiment, it is obvious that the control lambs had much longer (in fact 45 days longer) to become seriously depleted.

Another pasture factor which varies considerably during the grazing season is the mineral content of the sward. We now know quite a lot about the way in which stage of growth and the time of the year affects the chemical constituents of the pasture species (2). We would like to know more than we do of the reasons behind these changes and how we might influence them. Grass tetany, affecting the lactating cow or ewe in the early spring, has been the topic of much discussion and a great deal of work. Clearly, there are several reasons for the high ocurrence of this disorder in March and April, but foremost amongst these is the low content of magnesium in the grass at that time of year (3).

Much has been said about the part played by clover, which is rich in magnesium, in the prevention of grass tetany; but in fact even in an all-grass sward the magnesium content rises so clearly as the season progresses that the risk of grass tetany will not persist. I feel therefore, that probably the most important factor in the incidence of grass tetany is the production and use of early grass. The part played by fertiliser applications is closely linked with this, it is obvious that nitrogen applications are necessary for early grass; they cause some increase in the nitrogen content of the herbage, but one is faced with the alternative of using nitrogen and having a high protein product or not using nitrogen and having virtually no grass. Potassic fertilisers are rather different, the use of them in the late winter leads to a rapid uptake of potassium by the grass, which undoubtedly increases the risk of hypomagnesaemia. The use of potassic fertilisers during the late summer and autumn avoids this effect to a considerable extent. In passing, it may be worth commenting on the excessive use of potassic fertilisers on occasional farms—I know of several farms where the advice had to be given that no potassic fertiliser applications for pasture were needed for a few years. In this connection, advertising pressure to use compound fertilisers may suggest to the farmer that N, P, and K are always required together. For pasture, I can't see the value of potassic fertiliser in combination with nitrogen.

Returning to grass tetany, obviously there is no alternative if we want to utilise early grass for milk production (and of course we do)—extra magnesium will have to be supplied. Now if the supply of grass is inadequate for maintenance and production requirements, additional food may be desirable, and the magnesium, as calcined magnesite, can be combined with this. If, however, there is adequate grass and the cereal rations are given purely as a conveyor of magnesium, then I think other means are preferable and there are two practical possibilities. For the farmer who wants to be really sure, pasture dusting gives a good degree of safety. Calcined magnesite is applied, either by hand or using a spinner-type fertiliser spreader, at the rate of 28 lb. per acre (4). The use of molasses-magnesite mix in tubs gives a useful means of supplying magnesium, especially where the size of the area involved makes pasture dusting uneconomical. It has the disadvantage that one has to rely on the voluntary co-operation of each cow to ensure its success, but experience has shown that sufficient cows do co-operate. Of course one also gets the over-keen cow—the individual who feels it necessary to eat her neighbour's portion as well as her own, and the results are obvious but not serious.

It was interesting to compare the blood levels of cows on dusted pasture with those supplied with M.M. mix tubs on a very similar pasture (5). Although the average blood magnesium levels for each group were very similar—2.1 mg% for dusted pasture (21 cows) compared with 2.3 mg% (23 cows), the variation between individuals within the groups was quite different—the cows on the dusted pasture varying by $+/-$ .2 mg% whereas, those having free access to the tubs varied by $+/-$ .5 mg%. In dusted pasture no samples fell below 1.7 mg%, whereas, in the free access group 2 cows had magnesium values as low as 1.1 and 1.2 mg%. Obviously the chances of a failure in the latter group was far greater.

Of course part and parcel with the intensive grassland is the extended grazing season—with improved drainage, improved soil fertility and the possibility of spelling the pastures by controlled grazing, it is possible in most areas to extend the grazing season at both ends. In addition, most intensive systems provide for hay or silage to be taken as part of the system, so that animals will be, in effect, living in a largely self-contained nutritional environment. In many cases the only input is in the form of fertilisers (N, P and K) and lime. Even farm-yard manure, in that it is usually produced within the system, only returns some of the nutrients but cannot be looked on as a supply for new ones. The farmer relies on the soil as a supply source for a variety of major and minor elements and is fortunately seldom disappointed. Unfortunately, lime, which is a necessary soil conditioner and controls the uptake of certain elements which are toxic to plants, also controls the uptake of essential or undesirable elements for animal nutrition with, at times, unfortunate consequences. Whether, in the long term, we are creating problems as yet undetermined, is not within the ambit of this paper but there are some conditions which are becoming too well known for comfort and which do spring into prominence in systems such as I have described.

In East Galway and Roscommon for example, the light texture limestone soils, when developed in this way to a state of relatively high production, do not contain sufficient cobalt to maintain the health of rapidly growing lambs. Ewes, probably from the combination of age, low productivity and the availability of selective grazing for parts of the year (for example between weaning and flushing) do not show any ill effects.

Copper deficiency is another condition often associated with an intensive system, particularly one which involves calves or young cattle. In Ireland copper deficiency in cattle and cobalt deficiency in sheep can be looked on as our two most common animal trace element deficiencies. In the case of copper it is not a shortage of supply, but the inability of the animal to make full use of the supplies which are available. Many of the soils in North Leinster (limestone drift soils), and many of the cut-over bogs, as well as the marine alluvial soils, contain high levels of molybdenum. The availability of this molybdenum for herbage varies considerably depending on the soil, but it is increased as the soil pH rises. Thus the application of lime, particularly as large dressings, can release the element and result in a very high molybdenum content in the herbage. In spite of normal amounts of copper, the cattle are unable to maintain the level necessary for health. The exact reasons for this are not fully understood but it appears that the absorption of copper in the intestine is interfered with.

This is a good example of a disorder which, with the change to intensive systems, will become much more important. As the reduction in copper can be quite slow, the effects of the extra few weeks of the grazing season can be quite significant. The newborn calf is usually supplied with very high reserves of liver copper, but in the case of calves born in a high molybdenum area, this reserve can be reduced (6). Obviously this calf will be less capable of contending with the molybdenum excess as a weanling than a calf bought in from another area.

The effects of this on cattle production can be seen in some of our experiments (7). For instance, with single-suckled calves, copper treated groups can have an average weight in October, 100 lb. greater than the untreated control animals. Perhaps more important than the actual weight increment is the uniformity and healthy appearance of the cattle in the copper treated groups, compared with those that did not receive copper.

In a recent trial using Friesian bullocks, the effect on liveweight was again seen, although after a dry summer it was only noticeable in September and October, when the copper treated cattle put on up to 60 lb. more (8).

There is obviously considerable variation from one year to another, depending on the weather.

It is also apparent from our work that stock given a good supply of highly nutritious fodder will show the ill-effects of induced copper deficiency much more rapidly and more obviously than those kept in poor condition.

Since clover contains very much more molybdenum than grass, and since nitrogen appears to reduce the uptake of molybdenum by grass, an all grass-high nitrogen sward might be worth consideration. I mention this here to illustrate how much pasture management and the type of stock can influence a condition which might at first glance appear to be a simple matter of the shortage of a trace mineral.

Some intensive systems involve animals experiencing enforced under-nutrition for periods of the year when high production is not expected. The advisability of such procedures is questionable and I feel that in most cases the saving in costs is largely offset by the stress suffered by the animal and the resulting effects on health. The autumn nutrition of the single-suckler cow is an example, when a pregnant or early lactating cow is expected to survive on the remains of the last season's grass and the hope of silage later on. Winter tetany, a disorder closely akin to grass tetany in which low blood magnesium is usually seen together with reduced calcium, is known to occur under these circumstances. Although one would expect calcined magnesite to prevent this condition, its success is only moderate unless the standard of nutrition is improved—in fact the use of magnesite is generally not required when such cows are reasonably well fed. It may well be that much of the infertility seen in our dairy herds is the after-effect of a very moderate winter nutrition, since it is known that the nutrition of a pregnant cow has a subsequent effect on her reproductive performance (9).

I have not mentioned the role of intestinal parasites in animal ill-health, these are largely outside my own field. However, many of the considerations regarding nutrition and the length of the grazing season etc., which I have tried to relate to the mineral nutrition of the grazing animal, will also be relevant to the presence and effects of gastro-intestinal parasites. In addition one can get interaction effects, for example, in cobalt deficient lambs the ill effects of moderate worm burdens can be much more severe than in cobalt sufficient animals (10).

In summary, highly productive pastures will require efficient and well managed stock to utilise them profitably, giving reasonable financial returns. This high level of production by the individual animal involves considerable stress and shows up any weaknesses that may be present. There may be need to consider further the development of stock suitable for such intensive grassland.

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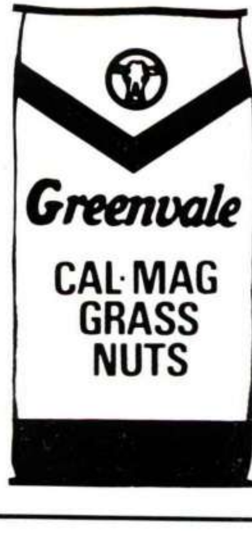

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Modern Methods of Swede Production and Traditional Methods of Swede Utilization

by

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Introduction

Although the area under swedes fell from nearly 200,000 acres to slightly less than 100,000 acres during the period 1930-1960, it is still the most popular root crop in this country. Shortage of labour is the main cause for this reduction in acreage. However, modern cultural techniques are gradually reducing the amount of hand labour needed and the acreage being grown is rising again.

The practice of growing swedes for *in situ* grazing by sheep is very old in Ireland and the present-day increase in the area grown is mainly for this purpose, particularly for hoggets.

The object of the present project at Oak Park is to obtain information on the production of the maximum amount of utilizable swede food per acre, at the minimum cost per ton. In order to get this information the following trials were laid down in 1965:

(a) Variety trials
(b) Spacing trials
(c) Herbicide trials

In order to find out if a particular variety was acceptable and if such a variety had any detrimental effect on the teeth when eaten, all the above trials were grazed *in situ* by hoggets. The average live weight gain of the 240 hoggets used to graze these trials was 12 lb./head in a period of 12 weeks.

As the investigations proceeded the results being obtained and the many queries coming in from outside dictated that additional trials both from a cultural and a utilization viewpoint were necessary. Therefore in 1966 "a time of spraying with paraquat" trial was added. In the spacing trial an "on the drill" treatment was included and the yield and percentage utilization was compared with the "on the flat" treatments. An N, P, K, spacing factorial trial was laid down in 1966, 1967 and 1968 to find out if it was necessary to vary the proportions of N, P and K as the plant populations changed.

In 1967 and '68 special areas of green top turnips, hard and soft swedes and marrow stem kale were grown and grazed separately by different breeds of hoggets. A long-term experiment to find the effect on sheep's teeth when grazed on hard (Bangholm) and soft (Broadland) swedes and marrow stem kale were grown and grazed separately by sowing" trial was added in 1968.

The varieties selected for these trials were the ones that had consistently given high yields of dry matter per acre over a wide range of soils for a number of years, in the trials conducted by the Plant Breeding Department of An Foras Taluntais. These varieties were Broadland, Bangholm and Wilhelmsburger. Tipperary, being a very popular variety was included from the start and later a few other varieties were added.

METHOD AND MATERIALS

(A) 1965 Trials

In 1965 all the cultural trials were laid down in 4 randomised blocks. All the trials were sown with the precision seeder to a pre determined stand and there was chemical weed control. After estimating the yield per acre the entire area was strip grazed across the treatments with mixed breeds of hoggets. When the swedes were grazed off as uniformly as possible the amount uneaten was estimated by lifting the uneaten portion at 4 randomised points in each treatment, in the variety and spacing trials.

Table 1

Variety trial 20m $\times$ 8 in

Plant population, no. of weeds and total and utilized yield/acre

Variety	Bulbs (no.)	Wt. Bulbs (tons)	Wt. Tops (tons)	Quantity eaten by sheep (tons)	Weeds per acre	
					Fathen	Red Shank
Broadland	27,440	30.286	3.089	25.39	6,080	4,800
Wilhelmsburger	29,080	28.357	3.357	23.90	6,440	3,400
Tipperary	25,640	29.821	4.107	24.28	5,600	3,160
Bangholm	29,840	26.643	3.643	22.80	5,440	3,600
S.E.	±815	±0.538	±0.329	±0.704	±462	±671

Table 2
Variety trial 16×12
Plant population, number of weeds and yield/acre

Variety	Bulbs (no.)	Wt. Bulbs (tons)	Wt. Tops (tons)	No. of weeds per acre	
				Fathen	Red Shank
Broadland	16,320	19.195	2.000	12,080	4,480
Wilhelmsburger	22,840	15.643	1.768	16,320	5,960
Tipperary	20,600	23,642	3.839	9,720	4,120
Bangholm	23,320	19.750	3.304	14,040	5,440
S.E.	±450	±0.988	±0.128	±1,348	±703

Table 3
Herbicides V. Cultivations
No. and yield of bulbs, cost of weed control and value of crop per acre at £2/ton

Treatment	Bulbs (per acre)	Bulbs (tons)	Cost of weed control (per acre)	Cost of weed control (per ton)	Value of crops (per acre)
Endothal/propham ...	11,380	26.06	£10/0/0	£0/7/8	£52/10/0
Paraquat	27,780	29.54	£3/15/0	£0/2/6	£59/0/0
Conventional	27,680	39.21	£9/10/0	£0/4/10	£78/0/0
Dimexam/OMU/BiPC ...	12,640	28.19	£4/12/6	£0/3/3	£56/0/0
S.E.	±904	±1.79	—	—	—

Table 4
Spacing trial
Effect of plant population on yield of bulbs and tops, and the amount utilized per acre

Treatment	Bulbs (no.)	Bulbs (tons)	Tops (tons)	Quantity eaten by sheep (tons)
20 in rows × 8 in	22,420	22.534	3.737	18.04
16 in rows × 8 in	29,387	21.431	4.165	17.03
12 in rows × 8 in	33,511	23.826	4.343	19.29
18 in rows × 18 in	13,360	17.122	3.016	14.98
12 in rows × 12 in	26,504	23.701	4.254	19.41
8 in rows × 8 in	41,033	21.035	4.782	16.24
6 in rows × 6 in	64,099	24.612	6.238	16.53
S.E.	±2,680	±1.005	±0.209	±1.018

(B) 1966 Trials

The variety trial was laid down in 6 randomised blocks. There were 4 rows (18 in. apart) in each treatment. The seed was precision spaced at 8 in. in the rows. Chemical and manual weed control were used.

Table 5
Variety trial (18 in × 8 in)
Plant population, yield, total dry matter and quantity eaten/acre

Treatment	Bulbs (no.)	Bulbs (tons)	Bulbs % D.M.	Tops (tons)	Necks (tons)	Total D.M. (tons)	Quantity eaten (tons)
Broadland	33,850	40.71	10.22	1.16	0.90	4.474	34.46
Wilhelmsburger ...	35,610	28.25	12.67	0.78	0.34	3.765	24.11
Tipperary	28,260	36.02	10.29	1.18	1.01	4.043	30.59
Bangholm	33,900	31.08	12.95	1.01	0.85	4.342	26.04
Pentland harvester	24,920	34.40	10.22	1.20	0.96	3.849	28.93
S.E.	±570	±0.62	±.08	±0.05	±0.04	±0.066	±0.60

There was no difference between the varieties as regards the incidence of bacterial and fungoid diseases but Pentland Harvester showed extensive symptoms of Boron deficiency and was the last variety to be grazed by the sheep. No variety had flowered by March 24. Tipperary and Pentland Harvester were on the point of flowering on March 26.

Broadland attained this stage on April 1, Bangholm on April 5 and Wilhelmsburger on April 8. Sheep were put to graze these observation plots on April 9. On April 24 85% Wilhelmsburger, 75% Bangholm, 60% Tipperary, 45% Broadland and 40% Pentland Harvester was eaten. On May 1, all the plots were equally well eaten.

Spacing trial

The spacing trial was laid down in 6 randomised blocks. There were 4 rows in all treatments except the 12 in. rows, where there were 5 rows. Each treatment was 70 yds. long. The seeds were precision spaced, weeds were controlled chemically and where necessary by hand.

Table 6

Spacing trial

Effect of different spacings on plant population, total D.M., total yield and quantity eaten/acre

Treatment	Bulbs (no.)	Bulbs (tons)	Bulbs % D.M.	Tops (tons)	Necks (tons)	Total D.M. (tons)	Quantity eaten (tons)
12 in × 8 in	51,605	36.2	10.19	0.745	0.723	3.880	30.10
15 in × 8 in	37,530	35.70	10.03	0.860	0.854	3.838	31.21
18 in × 8 in	33,504	38.02	9.88	1.292	1.084	4.098	33.49
12 in × 12 in	31,057	37.78	9.79	0.875	0.898	3.950	32.03
24 in × 6 in	32,015	36.21	9.71	0.923	0.872	3.766	30.43
24 in × 8 in	25,205	37.45	9.74	0.940	0.838	3.930	32.48
24 in × 6 in drills	33,527	36.28	10.06	0.866	0.765	3.860	31.58
24 in × 8 in drills	25,007	35.54	9.83	0.833	0.793	3.720	31.13
S.E.	±1,359	±0.83	±0.039	±0.039	±0.058	±0.075	±0.80

Age of stale seedbed trial

The object of this trial was to ascertain the most suitable time interval between preparation of the seedbed and sowing of the seeds, using the stale seedbed technique. The seedbed was finally prepared on May

2. 3½ pints Paraquat in 50 gal. water per acre was applied at three 2-week intervals to randomised plots. For the first two applications, the paraquat was applied immediately after sowing; for the latter two applications the plots were sprayed first and the seeds precision spaced about 1 hour afterwards. The herbicide burned off all the green herbage in all the treatments. In the "end of June treatment", although the leaves and stems of the knotgrass and red shank plants disappeared the plants were not killed. They produced new leaves and stems and completely colonised the plots, particularly the knotgrass. Some knotgrass plants grew to a size of 12 feet in diameter. There was no crop obtained from this last treatment.

Table 7

Age of stale seebded trial

Treatments, plant populations, yield and number of weeds/acre

Treatment	Age of Seedbed	Bulbs (no.)	Bulbs (tons)	Weeds (no.)
Sown and sprayed mid-May ...	2 weeks	30,490	8.93	(a)—
Sown and sprayed end-May ...	4 weeks	37,260	27.20	17,070
Sprayed and sown mid-June ...	6 weeks	35,020	25,41	2,880
Sprayed and sown 28 June ...	8 weeks	(b)—	—	—
S.E.		±1,190	±1.080	±1.580

a. The weeds so plentiful and entangled, it was impossible to count them.

b. The crop was not worth harvesting and knotgrass plants could not be separated.

Herbicides on Fresh and Stale seedbeds V Cultivations

This experiment consisted of 15 treatments and was laid down in six randomised blocks. Each treatment was 70 yds. long and consisted of 4 rows, 18 in. apart.

In the post emergence application of the nitrophene plots, the swede plants became badly twisted and distorted, but as soon as new leaves developed the crop recovered.

Table 8
HERCICIDES V CULTIVATIONS TRIAL
Treatments, no. bulbs and weeds, yield of bulbs, cost of weed control/acre

	Treatments	Roots (no.)	Roots (tons)	Weeds (no.)	Cost of weed control £ s. d.	Value of crops at £3/ton £ s. d.	Order of merit based on yield/acre
A	3½ pt paraquat/acre	37,085	29.8	18,310	3 5 0	89 8 0	7th
B	3½ pt paraquat+10 pt dimexan/OMU/BiPC mixture	35,368	30.9	10,837	7 17 6	92 14 0	4th
C	3½ pt paraquat+2 gal endothal/propham mixture	38,311	30.3	14,467	13 5 0	90 18 0	6th
D	3½ pt paraquat+steerage hoe (twice)	36,496	31.8	8,381	4 15 0	95 8 0	3rd
E	Control on stale seedbed (Precision spaced)	—	—	—	—	—	—
F	10 pt dimexan/OMU/BiPC mixture	30,070	21.8	41,318	4 12 6	65 8 0	13th
I	2 gal endothal/propham mixture	30,757	23.1	43,133	10 0 0	69 6 0	12th
J	10 pints dimexan/OMU/BiPC mixture+steerage hoe twice	29,776	29.1	14,680	6 2 6	87 6 0	8th
K	2 gal endothal/propham mixture+steerage hoe twice	30,707	25.9	15,214	11 10 0	77 14 0	11th
L	Conventional, thin by hand+steerage hoe twice	37,375	32.0	5,392	10 5 0	96 0 0	2nd
M	Control on fresh seedbed (Precision spaced)	29,923	17.1	54,770	—	51 6 0	14th
N	Control on fresh seedbed (Precision spaced)+steerage hoe twice	29,923	27.0	19,004	1 10 0	81 0 0	9th
O	10 pints 2, 4-dichlorophenyl, 4-nitrophenyl ether (Pre-emerg.)	31,002	30.6	10,410	10 0 0	91 16 0	5th
P	3½ pints 2, 4-dichlorophenyl, 4-nitrophenyl ether (Post-emerg.)	28,795	26.1	7,474	4 0 0	78 6 0	10th*
S	4 pints 2, 4-dichlorophenyl, 4-nitrophenyl ether—band spray +steerage hoe twice	28,746	34.0	2,989	5 0 0	102 0 0	1st

*There was considerable distortion and shrivelling of the swede leaves after the herbicide was applied; the loss in yield can be attributed to this set-back.

The suitability of different breeds of lambs for in-situ grazing of swedes

The swedes used for this trial varied in dry matter content from 9.71% to 12.95% results are given in Table 9.

Table 9
Details of live weight gain, tooth losses, duration of grazing period etc.

Breed	No. on expt.	No. not missing any teeth at end of trial	Total no. teeth missing or broken	No. died	Duration of trial period	Live weight gain (lb)
Cheviot	70	14	228	1	10 weeks	3.8
Galway	70	47	72	1	10 weeks	8.0
Suffolk-Cross	70	39	86	1	10 weeks	11.0
Black Faced Mountain	70	4	257	4	10 weeks	2.8

(C). 1967 Trials

The trials in 1967 were laid down in 5 randomised blocks and all experimental work was done in the same manner as in 1966.

Table 10
Variety Trial
Plant population, yields/acre and D.M. percentages

Treatment	Bulbs (no.)	Bulbs (tons)	Leaves (tons)	Necks (tons)	%D.M. in bulbs	%D.M. in leaves	%D.M. in necks
Broadland	18.570	28.79	1.24	0.80	8.78	15.08	12.68
Wilhelmsburger	20.810	27.12	0.86	0.54	9.72	15.08	13.46
Tipperary	17.730	28.04	1.43	0.76	8.80	14.34	13.28
Bangholm	20.990	28.44	1.81	0.62	10.60	15.52	14.42
Pentland Harvester	19.480	30.22	1.26	0.80	9.24	14.80	13.46
S.E.	±620	±1.34	±0.10	±0.05	±0.10	±0.16	±0.10

Table 11

Herbicides V Cultivations trial

Plant populations, yield of bulbs and tops/acre, and dry matter percentages

	Treatment	Cost of weed control 1 acre £	s.	d.	Bulbs (no.)	Bulbs (tons)	Tops (tons)	% D.M. in bulbs	% D.M. in tops
A	3½ pints paraquat in 50 gal. water/acre on a stale seedbed ...	4	0	0	18.880	26.85	3.08	8.92	11.98
B	Paraquat as above+steerage hoed twice	6	0	0	18,210	29.85	3.27	8.76	11.78
C	Conventional—sown thickly, singled and steerage hoed twice ...	12	0	0	28,310	36.62	4.07	8.66	12.14
D	Multi-presowing tilling, precision sown and steerage hoed twice	3	10	0	23,290	32.44	3.86	8.60	11.96
E	Control on fresh seedbed	—			21,050	11.40	2.44	9.52	12.28
F	3½ pints nitrophene+1 pint CIPC+50 gal. water/acre, overall post emerg. at 1-leaf stage	4	5	0	21,480	25.70	3.19	9.18	12.34
G	10 pints nitrophen+50 gal. water/acre, overall pre-emerg. on fresh seedbed	10	0	0	24,440	22.85	3.30	9.22	12.48
H	As in G+CIPC	10	15	0	20,510	19.28	2.71	9.34	12.22
I	As in F less CIPC	3	10	0	22,990	26.50	3.30	8.86	12.00
J	4 pints nitrophene+20 gal. water/band acre, pre-emerg. and steerage hoed twice	6	0	0	24,320	33.36	3.59	8.68	12.00
S.E.	... ...				±700	±1.36	±0.19	±0.11	±0.20

Table 12

Spacing trial

Effect of plant populations on yield and D.M. percentages

Treatment		Approx. area per plant (sq. in)	Bulbs (no.)	Bulbs (tons	Leaves (tons)	Necks (tons)	Gross (tons)	Eaten by sheep 1 (tons)	Bulbs	Leaves	Necks
A	12″×8″	96	45,650	27.96	1.26	1.27	30.49	22.46	8.96	17.80	13.36
B	15″×8″	120	38,770	27.26	1.23	1.23	29.72	21.36	8.88	17.54	13.45
C	12″×12″	144	35,120	26.13	1.11	1.07	28.31	21.53	8.80	16.80	13.12
D	15″×9⅗″	144	35,210	25.77	1.10	1.09	27.96	20.67	8.78	17.50	13.48
E	18″×8″	144	31,820	25.45	1.00	1.16	27.61	20.95	8.86	17.30	14.12
F	21″×6 6/7″	144	34,240	25.10	1.06	1.13	27.29	21.10	8.82	17.06	13.04
G	24″×6″	144	31,040	22.97	1.09	1.13	25.19	19.27	8.84	17.02	13.50
H*	24″×6″*	144	28,860	22.55	1.11	1.09	24.75	19.85	8.80	16.40	13.20
I	24″×8″*	192	22,920	20.85	0.99	1.01	22.85	17.45	8.58	16.44	13.60
J	24″×8″	192	27,540	24.61	1.07	1.01	26.69	20.81	8.96	16.82	13.18
P	16″×12″	192	30,560	25.92	1.15	1.06	28.13	21.71	8.72	17.26	12.30
S	18″×10⅔″	192	28,790	26.66	0.97	1.10	28.73	21.96	8.84	17.92	13.24
S.E.		—	±1,170	±0.81	±0.07	±0.07	—	—	±0.08	±0.45	±0.37

*on drills. 1. provisional results.

Table 13

Utilization trial (hard swedes)

Treatments, live weight gains and teeth losses

(Galway and Suffolk-cross hogget's)

Treatments	% D.M. in bulbs	No. teeth lost or broken	Lt. wt. gain (lb)
20 Galway hoggets on Bangholm swedes for 12 weeks	10.45	51	8.8
20 Galway hoggets on Bangholm swedes + 1 lb meal for 12 weeks	10.5	34	11.5
20 Galway hoggets on grass for 6 weeks and then 10 put on pulped Bangholm swedes for 6 weeks	10.65	0	4.4
20 Sulffolk-cross hoggets on Bangholm swedes for 12 weeks	11.0	66	7.1
20 Suffolk-cross hoggets on Bangholm swedes +1 lb meal for 12 weeks	10.9	41	17.4
20 Suffolk-cross hoggets on grass for 12 weeks and then 10 put on pulped Bangholm swedes for 6 weeks	10.65	0	4.0

Table 14

Treatments. live weight gains and teeth losses with soft swedes and turnips

(Blackface Mountain and Cheviot hoggets)

Treatments	% D.M. in bulbs	No teeth lost or broken	L. wt gain (lb)
20 B.F.M. hoggets on Broadland swedes for 12 weeks	8.8	9	17
20 B.F.M. hoggets on Broadland swedes + ¾ lb meal for 12 weeks	8.8	0	15.5
20 B.F.M. hoggets on green top turnips for 12 weeks	7.3	0	7.2
20 B.F.M. hoggets on green top turnips + ¾ lb meal for 12 weeks	7.3	0	12.2
20 B.F.M. hoggets on grass for 6 weeks and then 10 put on pulped Bangholm swedes for 6 weeks	10.65	0	7.7
20 Cheviot hoggets on Broadland swedes for 12 weeks	8.8	8	16.1
20 Cheviot hoggets on Broadland swedes + ¾ lb meal for 12 weeks	8.8	15	20.0
20 Cheviot hoggets on green top turnips + ¾ lb meal for 12 weeks	7.3	0	16
20 Cheviot hoggets on green top turnips for 12 weeks	7.3	2	8.5
20 Cheviot hoggets on grass for 12 weeks and then 10 of these on pulped Bangholm swedes for 6 weeks	10.65	0	9.6

Bullocks v. Hoggets swede Utilization Trial

In November 1967 a trial was laid down to find out if 2 year old bullocks would utilize swedes by *in situ* grazing as efficiently as hoggets. Forty 2-year old bullocks (with 2 permanent incisors) were randomly drawn into 4 groups of 10 each. Forty Galway wether hoggets were drawn into two random groups and forty Suffolk X wether hoggets were drawn into two random groups and the following treatments were arranged.

A. 10 Friesian x bullocks *in situ* grazing Bangholm swedes 10.6% D.M.
B. 10 Friesian x bullocks *in situ* grazing Bangholm swedes 10.6% D.M. + 4 lb. meal daily/head.
C. 10 Friesian x bullocks on self feed silage only.
D. 10 Friesian x bullocks on self feed silage only + 4 lb. meal daily/head.
E. 20 Galway hoggets *in situ* grazing Bangholm swedes 10.6% D.M.
F. 20 Galway hoggets *in situ* grazing Bangholm swedes 10.6% D.M. + 1 lb. meal daily/head.
G. 20 Suffolk x hoggets *in situ* grazing Bangholm swedes 11% D.M.
H. 20 Suffolk x hoggets *in situ* grazing Bangholm Swedes 10.9% D.M. + 1 lb. meal daily/head.

All bullocks were fed 7 lb. barley straw daily per head and the meal mixutre consisted of equal parts of rolled barley and dried beet pulp. The original intention was to keep the bullocks on the *in situ* grazing for 12 weeks, but they cut up the ground very badly, trampling and soiling the swedes. It was therefore decided to house the bullocks and feed them pulped swedes for the remaining 6 weeks.

Table 15
Weights, live weight gains and % utilization

Treatment	L.W. on 22-11-67 (lb)	L.W. on 3-1-68 (lb)	Gain in 6 weeks (lb)	L.W. on 14-2-68 (lb)	Gain on pulped swedes (lb)	Gross L.W. gain in 12 weeks (lb)	Average daily gain gain (lb)	% of bulbs util-ized
A	904	888	−16	899	11	−5	−0.06	47.8
B	907	923	+16	974	51	67	+0.8	45.6
C	890	903	+13	913	—	23	+0.27	—
D	883	929	+46	961	—	78	+0.92	—
E	99	—	—	108	—	9	+0.10	80.0
F	97	—	—	108.5	—	11.5	+0.14	80.4
G	99.7	—	—	106.8	—	7.1	+0.08	80.6
H	99.6	—	—	117.0	—	17.4	+0.20	80.4

(D) 1968 Trials

The following cultural trials were laid down in 1968:

(a) Variety trial, consisting of 8 varieties.
(b) Time of sowing trial, consisting of 7 different sowing dates.
(c) Age of stale seed bed, having 5 different soil preparation dates.
(d) Deep v. shallow sowing on stale seedbed.
(e) Herbicide trial, consisting of 10 different treatments.
(f) N.P.K. spacing factorial trial, identical with the 1967 trial.
(g) Spacing trial, having 12 different treatments.
(h) Time of spraying with nitrophene trial, having 12 different treatments.

All the returns to date for this year's trials are provisional because it has not been possible to have the figures statistically analysed.

Table 16
Variety trial
Yields per acre and percent dry matter

Treatment	Bulbs (No.)	Bulbs (tons)	Tops (tons)	% D.M. in bulbs	% D.M. in tops
Broadland	30,088	29.6	4.8	7.4	10.9
Wilhelmsburger	35,632	35.2	3.6	8.7	11.7
Tipperary	28,672	26.6	4.4	7.8	11.2
Bangholm	33,088	30.2	4.5	9.2	11.8
Pentland Harvester ...	28,376	28.1	4.5	7.8	11.6
Purple King	33,152	29.8	4.4	7.9	11.3
Magnificent	28,432	26.0	4.6	8.0	10.9
Peerless Purple top ...	27,008	29.3	2.9	7.6	11.4

Time of Sowing Trial

This trial was laid down in 5 randomised blocks. The seeds were sown 2 in. apart in 18 in. rows and there were 4 rows in each treatment. At the 3-4 leaf stage the crop was singled to 8 in. apart by hand. Weeds were controlled manually. The yield was obtained by harvesting 45.4 feet of the middle two drills in each treatment.

Table 17
Time of sowing
Treatments, yield per acre and % D.M.

Treatments	Bulbs (tons)	Tops (tons)	% D.M. in bulbs	% D.M. in tops
Sown 19th April	22.5	4.6	7.7	10.5
Sown 28th April	22.6	4.8	7.7	10.5
Sown 7th May	26.2	4.3	8.0	10.3
Sown 16th May	26.9	4.2	7.8	10.3
Sown 25th May	26.5	4.4	8.1	10.9
Sown 3rd June	24.2	4.3	8.0	10.5
Sown 12th June	18.8	3.1	7.9	10.6

Observations on this trial

There were very severe attacks of aphids on the treatments sown on the first three sowing dates. Any infection or attacks on the last four treatments came from the first three sowings.

A large sack of bulbs of each of the treatments was stored away immediately after harvesting, and storage investigations have been made on them.

Age of Stale Seedbed Trial

In the "Age of Seedbed" trial laid down in 1966, the seedbeds for all the treatments were prepared on the same date, and the dates of sowing and spraying varied. In this trial the dates of preparing the seedbeds varied and all treatments were sown and sprayed on the same day. This eliminated the risk of different sowing dates affecting the yield.

There were 5 dates of seedbed preparation and 2 rates of paraquat application. The treatments were as follows:

A. Soil prepared April 12, Sown May 31, 3 pts. paraquat, 7 weeks old.
B. Soil prepared April 12, Sown May 31, 4½ pts. paraquat, 7 weeks old.
C. Soil prepared April 19, Sown May 31, 3 pts. paraquat, 6 weeks old.
D. Soil prepared April 19, Sown May 31, 4½ pts. paraquat, 6 weeks old.
E. Soil prepared April 26, Sown May 31, 3 pts. paraquat, 5 weeks old.
F. Soil prepared April 26, Sown May 31, 4½ pts. paraquat, 5 weeks old.
G. Soil prepared May 3, Sown May 31, 3 pts. paraquat, 4 weeks old.
H. Soil prepared May 3, Sown May 31, 4½ pts. paraquat, 4 weeks old.
I. Soil prepared May 10, Sown May 31, 3 pts. paraquat, 3 weeks old.
J. Soil prepared May 10, Sown May 31, 4½ pts. paraquat, 3 weeks old.

Table 18
Plant population and yields per acre

Treatments	Bulbs (no.)	Bulbs (tons)	Tops (tons)	Total (tons)
A	24,832	22.4	2.5	24.9
B	23,808	24.9	3.1	28.0
C	25,744	27.5	3.1	30.6
D	23,352	26.4	3.1	29.5
E	26,624	28.5	3.3	31.8
F	27,264	29.3	3.6	32.9
G	31,104	30.3	3.6	33.9
H	31,104	29.5	3.8	33.3
I	32,128	30.4	3.5	33.9
J	30,976	30.4	3.6	34.0

Deep Sowing v. Shallow Sowing on a Stale Seedbed

Very often when seeds are sown on a 6-7 weeks old seed bed, many of the seeds are badly covered or not covered at all. Frequently, the soil that is dragged (by the drag chain of the seeder) into the groove containing the seeds is just hard dry crumbs of soil. In the case of the Stan-Hay seeder, the rear pressing wheel is too wide to fit into this groove and under the dry hard soil conditions associated with stale seedbeds, the rear wheel rides on the hard shoulders of this groove. Under such conditions the rear wheels play no part in breaking the little hard lumps of soil, which would help to cover the seeds.

It was hoped to get over this difficulty by fitting a $\frac{3}{4}$" x $\frac{3}{4}$" V belt to the middle of the rear wheels. The V belt would fit into the grooves and should help to break the lumps and press the soil down on the seeds. With this object in view the following trial was laid down.

A. Shallow with normal wheel, $\frac{3}{4}$" deep, Notch 5.

B. Shallow with V belt fitted, $\frac{3}{4}$" deep, Notch 5.

C. Deep with normal wheel, $1\frac{1}{4}$" deep, Notch 7.

D. Deep with V belt fitted, $1\frac{1}{4}$" deep, Notch 7.

Table 19
Gives details of plant population and yields of bulbs and tops/acre

Treatments	Bulbs (no.)	Bulbs (tons)	Tops (tons)	Total (tons)
A	19,488	21.1	3.01	24.11
B	20,504	23.6	3.18	26.78
C	22,432	25.2	3.37	28.57
D	23,360	24.9	3.47	29.37

Herbicide v. Cultivations Trial

The herbicide trial consisted of 10 treatments and was laid down in 5 randomised blocks. The stale seedbed treatments were 7 weeks old at the time of sowing the seeds. The treatments were as follows:

A. $3\frac{1}{2}$ pints paraquat in 50 gal. water per acre.
B. $3\frac{1}{2}$ pints paraquat in 50 gal. water per acre and steerage hoed twice.
C. Conventional method.
D. Multi-pre sowing tilling, tilled 6 times at weekly intervals.
E. Control.
F. Precision sown, weeded by hand and steerage hoed twice.
G. Multi-pre sowing tilling + steerage hoed twice.
H. 4 pints nitrophene + 20 gals. water, pre-emerg. band spray and steerage hoed twice.
I. 10 pints nitrophene + 50 gal. water over-all pre. emerg.
J. $3\frac{1}{2}$ pints nitrophene + 50 gal. water over-all post emerg., when the first true leaf was $\frac{3}{4}$" in diameter.

Table 20
Plant populations, yield of bulbs and tops and cost of weed control per acre

Treatment	Cost of weed control per acre £ s. d.	Bulbs (no.)	Bulbs (tons)	Tops (tons)	Gross yield tons	Value of crops at at £3/ton £ s. d.
A	4 0 0	28,544	14.5	2.6	17.1	43 10 0
B	6 0 0	25,728	16.7	2.8	19.5	50 2 0
C	12 0 0	41,180	31.2	4.0	35.2	93 12 0
D	4 0 0	29,412	7.4	1.9	9.3	22 14 0
E	—	26,240	4.5	1.4	5.9	13 10 0
F	10 0 0	28,784	28.0	3.4	31.3	84 0 0
G	6 0 0	31,524	17.9	3.1	21.0	53 14 0
H	6 0 0	29,936	18.8	3.5	32.3	56 8 0
I	10 0 0	26,432	4.9	2.4	7.3	14 14 0
J	4 0 0	26,496	8.0	2.1	10.1	24 0 0

Spacing Trial

This trial consisted of 12 treatments and was laid down in 5 randomised blocks. Each treatment had 4 rows and was 30 yds. in length. All treatments were on the flat. The seeds were sown with the precision seeder 1 in. apart and thinned by hand to the required spacings at the 3-4 true leaf stage.

The yield was obtained by harvesting 1 random drill from the middle two drills in each treatment. The bulbs and tops were weighed separately. There was an effort made to find out what weight of the bulbs was overground by cutting the bulbs across at ground level. After the crop was reasonably well grazed the uneaten portions in the remaining middle drill were lifted and weighed.

Table 21

Treatments, plant populations, yield of bulbs and tops/acre, % bulbs overgrown and % eaten by hoggets

Treatments	Bulbs (no.)	Bulbs (tons)	Tops (tons)	% bulbs over-ground	% D.M. bulbs	% D.M. tops
A 12″×6″ = 72 sq. in each	87,000	29.4	3.01	60.7	11.2	12.1
B 12″× 9″=108 sq. in each	65,200	31.9	3.01	67.2	10.9	12.2
C 12″×12″=144 sq. in each	43,500	32.1	2.91	67.9	10.4	11.3
D 18″× 6″=108 sq. in each	54,000	29.5	2.85	70.9	10.7	12.2
E 18″× 9″=162 sq. in each	37,600	31.0	2.81	74.7	10.7	11.6
F 18″×12″=216 sq. in each	27,300	32.1	2.61	77.6	10.2	11.5
G 24″× 6″=144 sq. in each	43,450	30.7	3.17	72.2	10.4	12.0
H 24″× 9″=216 sq. in each	29,000	32.5	2.96	76.0	10.3	11.4
I 24″×12″=288 sq. in each	22,000	32.1	2.62	77.5	10.4	11.4
J 30″× 6″=180 sq. in each	36,800	30.6	2.94	74.0	10.1	11.5
K 30″× 9″=270 sq. in each	23,200	30.8	2.80	78.9	9.8	11.3
L 30″×12″=360 sq. in each	18,500	31.0	2.39	80.0	9.6	11.1

Time of spraying with Nitrophene

It is well known that when nitrophene is applied post-emergence to swede plants that severe distortion of the leaves takes place. The reduction in yield (if any) caused by this distortion is not definitely known and there are various opinions on the subject. Tyson and Bartlett (1) claimed that the post-emergence application of 3½ pints of nitrophene per acre at any stage of crop growth from emergence to the 3-4 true leaf stage does not cause any reduction in yield. However, in 1966 trials, the yield per acre from post-emergence application of nitrophene was 4.5 tons less than from pre-emergence application, although in the visual assessment of weed control the post-emergence application was placed third and the pre-emergence application was placed fourth. In the estimation of weeds present at harvesting time there were practically 3,000 more weeds present per acre in the pre-emergence treatments. Also there was over 2000 more bulbs per acre in the pre-emergence application treatments. Further the recommendations on the leaflets being distributed with nitrophene are changing. Some years ago, application at the 3 rough leaf stage was recommended; in 1968 it was recommended to apply the herbicide when the first true leaf was $\frac{3}{4}$" across.

In view of these diverse findings it was decided to design a trial that might measure the effect of this distortion on yield. The following treatments were laid down in 5 randomised blocks. All treatments were sown on May 27.

A. Soil prepared May 21, herbicide applied June 8, Cotyledon fully expanded.

B. Soil prepared May 21, herbicide applied June 12, 1st true leaf $\frac{3}{4}$" across.

C. Soil prepared May 21, herbicide applied June 15, 2nd true leaf $\frac{3}{4}$" across.

D. Soil prepared May 21, herbicide applied June 18, 3rd true leaf $\frac{3}{4}$" across.

E. Soil prepared May 24, herbicide applied June 8, Cotyledon fully expanded

F. Soil prepared May 24, herbicide applied June 12, 1st true leaf $\frac{3}{4}$" across.

G. Soil prepared May 24, herbicide applied June 15, 2nd true leaf $\frac{3}{4}$" across.

H. Soil prepared May 24, herbicide applied June 18, 3rd true leaf $\frac{3}{4}$" across.

I. Soil prepared May 27, herbicide applied June 8, Cotyledon fully expanded.

J. Soil prepared May 27, herbicide applied June 12, 1st true leaf $\frac{3}{4}$" across.

K. Soil prepared May 27, herbicide applied June 15, 2nd true leaf $\frac{3}{4}$" across.

L. Soil prepared May 27, herbicide applied June 18, 3rd true leaf $\frac{3}{4}$" across.

The object of changing the date of seedbed preparation was to have a larger number of weeds emerge at the optimum time for herbicide application. Unfortunately there were large numbers of Shepherds purse, Groundsel, Chickweed, Fumitory, Sow thistle, Wild pansy, Speedwell, Deadnettle and some Charlock. The herbicide did not control these weeds in any of the treatments, and many Lambs quarter plants were not controlled. In all the treatments, the plants became disotrted. In mid July when the weeds were about 18" high the Swede crop was practically smothered and the weeds were pulled out to prevent seeding.

Summary

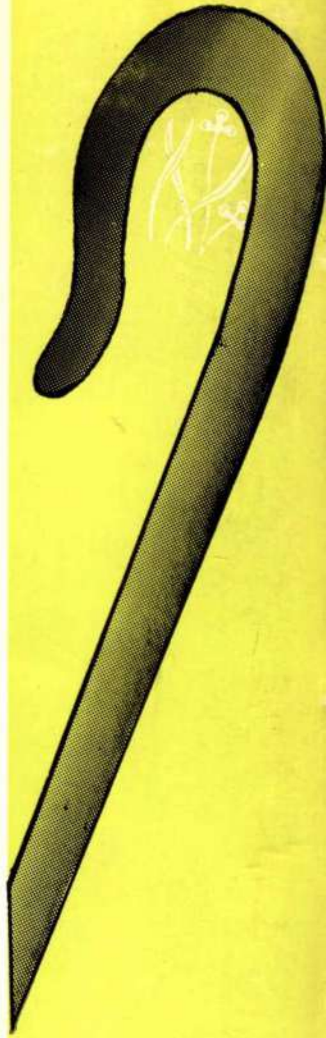
1. Swede growing by the stale seedbed method can give satisfactory crops of turnips and swedes.

2. The optimum age for the stale seedbed is 3-4 weeks and it should not be prepared until late April. Too early preparation does not permit all weed seeds to emerge in the 4 weeks and if left longer than 4 weeks the soil hardens, giving a reduced crop population and reduced yield. The weeds Redshank, Knot grass and Shepherd's purse will recover from paraquat application and take over a stale seedbed completely if the seedbed age extends beyond 4 weeks.

3. In grazing trials with swedes there were no varietal preferences when grazed by sheep. Bangholm swedes were responsible for a greater loss of milk teeth in hoggets than were either Broadland swedes or Greentop turnips.

4. Average liveweight gain of hoggets on swedes showed wide variation between breeds and between years.

5. The percentage of the swede utilised *in situ* was as high in crops grown on the flat as that from crops grown on the drills. The utilisation was better in low density (20,000/ac.) than high-density (45,000/ac.) crops.



THE IRISH GRASSLAND ASSOCIATION was founded in 1947 with the aim of promoting the knowledge of grassland production.

In 1961, the name of the Association was modified, in recognition of the fact that good grassland husbandry is intimately associated with, and inseparable from, good livestock husbandry.

The Association provides an opportunity for those interested in modern grassland farming to gather and interchange views and ideas; it provides a platform for forward-looking farmers and scientists to expound their ideas; it fosters and encourages research into the production and utilisation of grassland, and it aims to co-operate with organisations which has in common the improvement of grassland farming.

If you or your organisation would like to join the Irish Grassland and Animal Production Association, the Secretary, 24 Earlsfort Terrace, Dublin 2, would be pleased to hear from you.

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