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Cattle

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BEEF PRODUCTION

An Economic Report

J. S. Kurta

Edited by F. G. Sturrock

Agricultural Economics Unit
Department of Land Economy
University of Cambridge

1972

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A COMPARISON OF BEEF PRODUCTION SYSTEMS

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Foreword

There can be little doubt that of all farm enterprises, cattle are the most difficult to assess in economic terms. There are indeed pessimists who maintain that every bullock dies in debt but farmers still continue to rear cattle. They do so for a variety of reasons, not all of them economic. Traditionally cattle were fattened on arable farms to tread straw and make manure to grow crops. But this is no longer so compelling a reason because fertility can generally be maintained by purchasing fertiliser or in other ways. The keeping of cattle is sometimes justified as a means of using pasture or by products that would otherwise be unused or labour that would otherwise be idle. These are important considerations but by themselves, they are a poor excuse for an enterprise that loses money. In the long run therefore cattle should be expected to show a profit in their own right and with care it should be possible to select a system that will produce a profit on most types of farm.

There is another point. Cattle frequently change hands and calves reared on one farm are finished on a second or even a third. The total returns will thus be divided between these stages. It might be supposed that although prices fluctuate, supply and demand should in the long run ensure a reasonably fair division of profits between these stages. But this is not always true and the fattener for example may continue to lose money at the expense of the rearer because he tends to overbid for stores. Sometimes this is because the farmer has no reliable criteria by which to judge the profitability of cattle on his farm.

The aim of this report is to attempt to answer some of the problems already mentioned. To do so, Part I is devoted to describing alternative systems of beef production and assessing their advantages and disadvantages. One method of classifying systems would be according to final product i.e. baby beef, 18 month fat cattle, 2½ year old fat cattle etc. Such a comparison would be interesting to the farmer who carried cattle from birth to slaughter but would not help the majority who keep cattle for only one stage of development. The classification is therefore based on the choices open to the farmer. He can start with calves from a dairy herd or from beef cows. He can rear them intensively as barley beef or he can sell them as stores at various ages. He can buy stores for grazing on pasture or for feeding in yards. He can time his purchases and sales to catch the best prices in autumn and spring. Among the many permutations that these alternatives provide, the author has selected 32 systems that are of importance in practice. The codes used to describe them may at first seem difficult to follow but they are in fact a form of shorthand that is easy to understand. The returns to land, labour and capital are then assessed in each case.

The criteria used to judge the merits of each system are according to the return obtained for the resources used. The most important resource is usually capital and the result is given as the "discounted cash flow" over ten years from an investment of £5,000 (i.e. the surplus left after the cattle enterprise has paid all costs including 10% interest on the capital invested). Other criteria are also given—return per acre, per head, per hour of labour or per unit of housing in case these are the factors that limit the farmers' freedom of action. Still another criterion is the extra income that cattle would produce on typical farms. A recommended list of systems is then given with indications of the merits of each. There has been some increase in beef prices since this data was collected but as this has been matched by higher costs, the conclusions (particularly the orders of preference) should still be valid.

The author is indebted to the many farmers who co-operated by weighing their cattle and providing the other information necessary for this study. The original manuscript has been extensively edited by the present writer but the author is entirely responsible for the data presented and the opinions expressed.

F. G. STURROCK

Director, Agricultural Economics Unit

PART I

A COMPARISON OF BEEF PRODUCTION SYSTEMS

Chapter 1. Introduction and Resume

The aim of this publication is to assess the economics of beef production—particularly on an arable farm. Part I is devoted to a comparison of different systems and, as will be seen in Chapters 2 to 5, several different criteria have been used. It may be asked why this should be necessary. Why cannot the economist devise a simple test against which different systems could be compared? Is it not enough to calculate the costs and returns for each type of beef herd and choose the one with the largest profit?

If the farmer has a specialist beef unit with its own labour force and buildings and uses grain with a definite market price, then it is a simple matter to calculate a separate profit for this enterprise. In most cases, however, the beef herd is inextricably woven into a farming system and uses inputs that have no other use. Beef cattle may use labour in winter which would otherwise be idle. They may use byproducts such as sugar beet tops that have no cash value or pasture that cannot be ploughed and used for crops. The solution used in this investigation was to charge items such as barley that could have been sold if not fed to cattle and not to charge items such as byproducts or labour that would have been wasted if the cattle had not been on the farm.

Having ascertained the return, what standard of comparison can be used to compare systems? Profit per head would not, for example, be satisfactory because some cattle are kept for a much longer period than others and should therefore show a larger profit. Inputs also vary in a way that may not show up in the profits. A single-suckled herd has a heavy capital investment in a breeding herd whereas purchased calves have none. An intensive calf-rearing unit requires far more labour per head than a herd of cattle grazing out of doors.

One method of putting all inputs and outputs on a common footing is to express the result as a *return on capital.* As can be seen from Table[1] the best returns to capital come from rearing pail-fed calves. This is hardly surprising. Capital requirements are modest because only calves are bought at the beginning and if they are sold at three months, the farmer can turn his working capital over four times a year. Further down the list appears barley beef and some of the more intensive 14 and 18 month fattening.

Although an important criterion, return to capital should not be used alone. The farmer may have ample capital or at least enough at the time of the year when it is needed for cattle. After harvest an arable farmer usually has plenty of cash to buy cattle for wintering even if he is short of capital in spring.

Another important criterion is the return *per acre.* It will be seen (Table 1) that in some systems the gross margin per acre can be as much as £40 to £80 or even more, as high a return as could be obtained from cash crops. Sometimes, however, these returns per acre are somewhat artificial because the chosen system requires hardly any land. Intensive calf-rearing for example requires hardly any land except to grow the small amount of hay consumed. Most of the food comes from barley and other grains, the acreage of which is not included[2]. Further down the list, some multiple-suckling and rearing and fattening systems use an acre or more per head and return gross margins of £20 to £30 per acre. This is a very fair return for unploughable pasture but not enough to compete with cash crops—except as a

[1] For an explanation of the system codes, see Table 5, page 15.

[2] Cereal crops are counted as cash crops. If the grain is fed, it is 'sold' at market price to the livestock.

ley intended as a break crop. Further down the list (see Table 8) single-suckling and a number of the small stores show returns of only £10 to £20 an acre and the summering of forward stores is below £20—a poor return unless no better use can be found.

Table 1 Systems giving the Highest Return to Single Inputs

To Capital (per £5,000 over 10 years D.C.F. discounted 10%)			*To Land (per acre of pasture and forage)*			*To Labour (per hour overall)*		*Per Head*		
System	*Capital per head*	*Return*	*System*	*Acres per head*	*Return*	*System*	*Return*	*System*	*Months Duration*	*Gross Margin*
	£	£			£		£			£
PF–S3	20	13479	PF–S3	None		S24(S)–F30	1·8	SS–F24	24	48
PF(A)–S14	45	11402	PF(A)–S8	0·1	123	S8(S)–S14	1·5	PF(A)–F24	24	43
PF(A)–S8	36	9129	PF(S)–S8	0·1	113	S14(S)–S20	1·2	MS–F24	24	40
PF(S)–S8	36	8324	PF–F12*	0·2	85	PF(A)–S14	0·9	SS–F14	14	39
PF(A)–F24	94	8269	PF(S)–F12*	0·2	85	PF–F12*	0·8	SS–S14	14	37
PF(S)–S14	48	7603	PF(S)–S14	0·4	40	PF(A)–S8	0·8	SS–S20	20	37
MS–S14	53	6736	PF(A)–S14	0·5	38	PF(A)–F24	0·8	PF–F24	24	33
MS–F24	107	6620	PF(A)–F18	1·0	31	PF(S)–F12	0·8	PF(A)–F18	18	31
SS–F14	110	6190	MS–S8	0·5	28	SS–S8	0·8	SS–S8	8	31
S8(S)–S14	46	5986	WSS–F14	0·3	25	PF(S)–S8	0·7	MS–S20	20	23
PF(S)–F12*	65	5948	PF(A)–F24	1·8	24	PF(A)–F18	0·6	MS–S14	14	21
PF(A)–F18	90	5927	MS–S14	0·9	24	SS–S14	0·6	PF(S)–S20	20	21
PF–F12*	48	5795	PF(A)–S20	0·8	23	PF–S3	0·5	PF(A)–S14	14	19
MS–S8	98	5785	PF(S)–F24	1·6	21	SS–F14	0·5	PF(A)–S20	20	18
SS–S14	110	5764	MS–F24	2·2	18	PF–S20	0·5	PF–F12*	12	17

*Barley Beef

System Code—First half (before hyphen) describe animal as bred or purchased; second half describes it as it leaves as fat or store:

First half:
- PF Pail-fed calf
- SS Single-suckled calf
- MS Multiple-suckled calf
- S8 8-month store
- (A) Born or purchased in autumn
- (S) Born or purchased in spring

Second half:
- S20 Sold as 20 month store
- F30 Sold as 30 month fat

If (A) or (S) not specified, born or purchased all year round.

With increasing scarcity of labour, return *per man hour* is becoming more important. Some cattle enterprises show returns of £0·80 to £1·80 per hour, a very fair return. Mature cattle for example require very little attention and thus show a good return for such time as is spent on them. In examining returns to labour, the farmer should bear in mind the fact that although the worker expects the same wage all the year round, his value to the farmer depends on the season. In winter, when bad weather stops cultivation, time may be of little account but when grain or roots are being harvested, a man hour can be worth many times the wage paid. The balancing of marginal values of labour that can be used for alternative uses is one that can be calculated with linear programming. In this case, the computer selects the system that best utilises the scarcest resource available. This may not necessarily be the system that by itself appears the most profitable. This aspect is dealt with in Chapter 5.

To bring together these various tests, a list is given (Table 2) of the 15 systems out of the 32 systems considered in this report[1] which appear to have merit. The criteria are given in the order: returns to capital, returns per acre, appearance in computer plans, returns per man hour, and finally returns per square yard of housing. According to whichever resource is most valued, a system can be chosen to suit the circumstances. As the farmer is often short of several of these resources, the choice may rightly fall on the one that satisfies the largest number of these criteria.

[1] These 32 systems are illustrated in Figure 1 page 9.

Table 2 Recommended Systems of Beef Production

System Code	Start with	Finish with	Months on Farm	Return on:— Capital	Acres	Housing Space	Labour: Early Spring	Late Spring	Early Autumn	Late Autumn	Overall	In Computer[4] Plans
No. 1. PF–S3	Pail-fed Calf[3]	3m Calf	3	XX	XX[1]	X						X
2. PF–F12[5]	,, [3]	12m Fat	12	X	XX		X			X	X	
3. PF(A)–S8	,, (autumn)	8m Store	8	XX	XX			X			X	X
4. PF(A)–S14	,, (autumn)	14m Store	14	XX	X	X	X	X		X	X	X
6. PF(A)–F18	,, (autumn)	18m Fat	18	X	X			X				
7. PF(A)–F24	,, (autumn)	24m Fat	24	XX		X	X	X				
8. PF(S)–S8	,, (spring)	8m Store	8	XX	XX					X		X
11. PF(S)–F12[5]	,, (spring)	12m Fat	12	X	XX					X	X	X
14. SS–S14	Single-suckled Calf[3]	14m Store	14	X		X[2]			X			
16. SS–F14	,, (spring)	14m Fat	14	X		X[2]			X			
19. MS–S14	Multiple-suckled Calf[3]	14m Store	14	X								
21. MS–F24	,, ,, [3]	24m Fat	24	X								
25. S8(S)–S14	8-month Store (spring)	14m Store	6	X		X[1]	X				X	X
28. S14(S)–S20	14-month ,, ,,	20m Store	6			X[1]		X		X	X	
32. S24(S)–F30	24-month ,, ,,	30m Fat	6			X[1]	X			X	X	X

[1] None used [2] If the cows are outwintered [3] All the year round [4] Small numbers ignored [5] Barley Beef

X Good Return XX Very good return (indicated for land and capital only)

It will be appreciated that the figures given are those that applied when this investigation was carried out and are liable to vary. By and large, however, small changes in cost since then have been matched by adjustments in price. In the absence of any drastic change, therefore, the orders of preference suggested should not have changed appreciably. The relative profitability of different groups depends of course partly on costs but mainly on the market prices for different age groups. If, for example, farmers realised that the younger stages were more profitable than the older, they could bid up the price of calves and let the price of forward stores fall. Farmers, however, have reasons other than profitability for choosing mature animals—they are less of a responsibility or they give manure for the potatoes. For this reason, price differentials change slowly. Meantime, the farmer looking for a genuine profit from beef cattle can find it in spite of the popular belief that cattle never pay. It is asking too much to expect a list of 'best buys' in choosing a system of beef production. Within the limitations stated, however, this report is perhaps as near as one can go to providing such a guide.

While Part I of this report deals with the choice of system, Part II deals with the factors affecting the profit margin for any given system. The data for Part I was collected over a number of years from nearly 300 farms in East Anglia, covering over 10,000 cattle.

Much of the information used in Part II was collected in co-operation with the Eastern Counties Beef Recording Society and the National Agricultural Advisory Service and use has been made of their recording schemes. The results gave a usable sample of 280 pairs of weighings on 184 individual groups of cattle from 99 farms, covering nearly 4,000 head. Although the results obtained from this investigation could be applied in areas other than East Anglia, the input-output coefficients may differ in detail. This applies especially to grazing because the output per acre is higher in some regions than others. In part, this is due to the more suitable climate, and partly due to the amount of attention given to grass cultivation. In the Eastern Counties, for example, grass does not always receive the attention that is given to arable crops.

Chapter 2 Systems of Beef Production

In comparison with other farm enterprises, beef production has certain characteristics of its own.

1 **The production cycle.** Unlike cash crops that have an annual cycle, the beef cattle cycle can vary from a few months to several years. Once a system is established, however, there is an annual batch, or in some cases a continuous flow of stock to the market.

2 **Flexibility.** Compared with other livestock enterprises, beef production is very flexible. To produce milk, specialised buildings and equipment are required and the herd may be built up over a long period. This means that a decision to start or stop milk production is a major event not to be lightly undertaken. By contrast, cattle rearing and fattening can be given up at any time simply by not buying calves or stores, and can be re-started again just as easily. A breeding herd of beef cows is a more stable unit but this is usually the only exception.

Again, there is a wide choice of system depending on the size of cattle kept, the season when they are bought, the season when they are sold and the intensity of feeding. Not only is this so, but the system can be changed from stores to fat cattle or from grazing to grain feeding without much difficulty. By contrast, dairying is much more rigid and once a system has been chosen, changes are difficult and expensive.

Because of this flexibility, a number of management decisions have to be made when starting beef production. Indeed, because each system uses a different combination of inputs, it is unwise to regard beef production as a single enterprise. It is a series of enterprises with different requirements of buildings, crops and labour. If this point is realised, the reader will not expect a single recommendation of one best universally profitable method of beef production suitable for all farms. As each farm has different amounts of land, labour and capital, a beef system profitable on one farm may not be profitable on another.

In deciding on a system for any given farm, the problem is twofold. First, one must decide on a system, and having done so, it then remains to maximise profit within that system.

Due to the flexibility of beef production, there is almost an infinite variety of systems, particularly if we include store production as well as fattening. Although East Anglia is traditionally an area where animals are finished, a surprising number of farms produce stores, especially younger beasts. Store production was therefore included in addition to fattening. Indeed, more cattle storing than fattening systems are described, not because stores are more important but because there is a much wider range of ages at which the cattle can be sold.

Thirteen systems of producing fat cattle are included and nineteen of store production, giving a total of thirty-two, as shown diagrammatically in Figure 1.

Figure 1 Systems of Beef Production

SOLD FAT

PAIL FED	SUCKLED	STORES
PF — F12	SS — F14	S20(A) — F30
PF(S) — F12	WSS(A) — F14	S20(S) — F30
PF(A) — F18	SS — F24	S24(A) — F30
PF(S) — F24	MS — F24	S24(S) — F30
PF(A) — F24		

SOLD AS STORES

PAIL FED	SUCKLED	STORES
PF — S3	SS — S8	S8(A) — S14
PF(A) — S8	MS — S8	S8(S) — S14
PF(S) — S8	SS — S14	S8(A) — S20
PF(A) — S14	MS — S14	S8(S) — S20
PF(S) — S14	SS — S20	S14(A) — S20
PF(A) — S20	MS — S20	S14(S) — S20
PF(S) — S20		

System Code—See Table 1, page 6.

Physical Input-Output Data

There is always a difficulty in selecting the level of performance to use in comparing systems. The basis used was to adopt the typical methods and levels of performance found on East Anglian farms. But the exceptionally skilled or fortunate farmer will make more profit and his less fortunate neighbour will make less than is suggested here. To take an example, a farmer buying forward stores in autumn to sell in the spring will make no profit at average levels of performance. Indeed he will not recover his variable cost. Some farmers nevertheless can make a profit at this game by clever purchase of stores, but it would be misleading to expect every farmer to follow suit because they may lack the flair to pick up bargains in the market.

There is also the problem of knowing which systems to include. The rule adopted was to include only systems practised by enough farmers to give reliable input-output data. Experimental and rather unusual systems were omitted even when they were being practised successfully by one or two farmers. It seems unsafe to assess them until more reliable data is available. To take an example, cheap low-protein diets are being tried with some success at the Grassland Research Institute at Hurley to rear young calves purchased in spring. But as only one farmer in the Survey was rearing calves this way, it was considered best to take as typical the indoor rearing system adopted by all the other farmers. In some cases these 'typical' systems could have been improved, often by fairly simple adjustments. They have not been changed, however, the aim being to compare the economic implications of beef production methods as at present carried out by reasonably competent producers.

Similar tactics were adopted when calculating food requirements. Unusual foods fed on only a few farms have been omitted from averages because it is unrealistic to divide these small quantities by the total number of herds. Any given system thus includes the feeding stuffs used by most farmers in the average quantities that they used.

At the same time, it seemed prudent to omit obviously inefficient methods used by a minority of farmers. To take an example, some farmers appeared to feed excessive quantities of concentrates to single-suckling cows. This seemed unnecessary because cows that need heavy feeding to rear a calf are unsuitable and should not be kept for this purpose. Such examples were therefore omitted from the sample. Indeed, except for concentrates used as a bait to induce cows to consume magnesite (and avoid hypomagnesaemia) very little concentrate was used. Creep feeding of calves was rarely practised. One farm where calves were creep fed and weighed regularly seemed to show an economic gain in weight when the calves were sold the following spring. However, on the basis adopted, creep feeding has been omitted.

The season for calving single-suckling cows in East Anglia is almost always from Christmas to March, and difficulty was experienced in finding any that calved in autumn. Early-spring is thus the normal practice and this was the one included in this study.

Table 3 sets out the physical inputs for rearing calves to eight months for pail feeding, single-suckling and multiple-suckling. Casualties are allowed for by charging their food to the survivors. Rearing

Table 3 Physical Inputs for Rearing Calves and Alternative Store Periods

	Pail Feeding	*Pail Feeding*	*Single-Suckling*	*Multiple-Suckling* (6 *calves per cow*)	*Store Period* 8–14 *months*		*Store Period* 14–20 *months*	
	0–3 *months**	0–8 *months*	0–8 *months*	0–8 *months*	*Summer*	*Winter*	*Summer*	*Winter*
Concentrates (cwt)	1·6	8·7	3·5	9·4	4·3	6·6	—	6·9
Hay (cwt)	0·5	4·8	7·0	8·1	0·6	12·6	0·6	8·0
Straw for feed (cwt)	—	0·3	9·0	2·3	0·2	7·0	—	3·0
Succulent fodder (cwt)	—	0·7	73·0	13·6	2·7	31·4	—	54·0
Grazing (acres)	—	negligible	1·9	0·25	0·43	—	0·84	—
Labour (direct) (hrs)	6·0	14·0	21·5	30·0	3·8	15·6	2·0	14·0
Approx. Weight of Animal at end of period (cwt)	1·5	4·0	4·5	4·0	6·25	5·5	7·75	7·75

*Usually 1–2 weeks old when purchased, on farm 8 weeks, therefore 9–10 weeks old at sale.

calves to ten weeks is also included, as many intensive beef producers prefer to buy animals past this difficult rearing period. As an investment, this is an attractive enterprise, particularly where accommodation is limited. This type of intensive rearing was, however, in its early stages on most of the farms studied. New or at least fresh buildings were being used, skilled rearers were being employed, and the calves coming in batches from reputable sources. The rearer refused calves he did not like and usually had an arrangement for them to be replaced. If the calf died within a given time of delivery, the farmer's money was refunded, provided that the calf was later found to be infected at time of delivery. Hence the calves were healthy and well reared, with little infection on the premises. Mortality rates were consequently low, not above 5 per cent. At present prices, margins per head are low, and even so, rearers are often finding difficulty in disposing of their calves. Anybody contemplating this type of calf rearing would be well advised to get firm contracts for supply and disposal before starting, to get calves from a reputable source, and to employ skilled rearers. Even so, it is a risky enterprise.

Stores from 8 to 14 months and from 14 to 20 months, reared during either summer or winter, are also included. Inputs varied little, irrespective of the method of rearing, provided that the 8 to 14 month animals were all going to be carried to a mature age. Single-suckled calves were usually put on a fairly intensive ration in order to sell them at 14 months. Some were sold fat, others were sold as stores, usually at premium prices. Their fate was not known, but a number were probably graded shortly after sale. A knowledgeable purchaser, intent on making a profit, as opposed to viewing some pretty cattle, would certainly not purchase them at a premium for grazing. For this reason, such animals were not included in the 8 to 14 month store rearing figures.

Table 4 shows inputs for fattening cattle. The first two columns deal with mature stores, either purchased at or reared to about 8 cwts.

Table 4 Physical Inputs for Fattening Periods

		*Stores of about 8 cwt**		*Semi-intensive Autumn-born calves Slaughtered at 18–20 months (One summer at grass)*	*Weaned singled-suckled Calves at 8 months Slaughtered at 14 months*	*Intensive Beef Slaughtered at 12 months*
		Winter fattening	*Summer fattening*			
Concentrates	(cwt)	12·7	—	24·8	14·0	32·0
Hay	(cwt)	10·0	—	15·0	8·0	6·0
Straw for feed	(cwt)	5·0	—	7·0	4·0	—
Succulent fodder	(cwt)	41·0	—	38·5	32·0	—
Grazing	(acres)	—	1·0	0·5	—	—
Labour (direct)	(hrs)	2·2	2·0	32·0	16·0	17·0
Weight at sale	(cwt)	10·5	10·5	9·0	7·5	8·0

*When purchased, stores were almost invariably not weighed; this weight is an estimate only

Although summer fattening is not widely practised in East Anglia, this is a relatively trouble-free way of using grazing that happens to be available. Buying of stores is the all-important factor. If a mistake is made it cannot be corrected because the purchase price is 94 per cent of the variable cost.

Winter fattening is widely practised, either because it is traditional and yards are available or, more rationally, to get manure for crops such as potatoes. The system was 'tailor-made' to fit arable farming as formerly practised, but it has outlived its usefulness. Before the advent of sugar beet, cattle used the fodder roots grown as a cleaning break in the rotation. The roots were also regarded as a restorative crop because the F.Y.M. produced by the cattle was applied to the root break, and the residues improved the following corn crop. But while the value of F.Y.M. should not be underrated, especially on light soils, many arable farmers grow corn year after year with apparent success, using herbicides to kill the weeds and fertilisers to maintain fertility. Thus the need for fodder roots and cattle to eat them is much dimished. If roots are still grown, it is as a cash crop in their own right, such as potatoes and sugar beet. Some cash root crops such as sugar beet do, however, have byproducts valuable for

feeding cattle, and it became the practice to use them to replace fodder roots formerly grown for the winter fattening of mature stores.

With a supply of byproducts for feeding and a supply of labour not otherwise employed, cattle fattening of this type could be quite profitable. When the cereal harvest was the busiest time of the year, then a labour force large enough to deal with the harvest had time to spare to tend cattle in autumn and winter. Now that the combine has eased the harvest season and allowed a reduction in staff, the late autumn is the bottleneck. As a result the tending of cattle and the collection of byproducts for them to eat may conflict seriously with the harvesting of cash root crops such as sugar beet or potatoes. It is normally not possible to delay the yarding of cattle until the peak labour demand is past, because the graziers selling them cannot retain them beyond the normal grass season without making special arrangements to obtain fodder or foggage. Indeed if they did so, they would be tempted to carry them on to Christmas and sell them fat.

If the main labour peak is in late autumn, the farmer who carries cattle at that period could just as easily carry them for the rest of the year when there is less pressure on labour supplies. Thus systems that entail the keeping of cattle all the year round become much more attractive. They have the added benefit that rearing is combined with fattening and the farmer reaps the profit formerly taken by the rearer.

A system that uses spare labour in winter but avoids the late autumn peak is the semi-intensive system of buying calves in autumn, turning them out to grass in spring and then yarding them to sell fat at 18 to 20 months old, shown in the third column of Table 4. Such calves are usually bought in early November, but if this interferes with field work, purchase can be delayed a few weeks. It is said that calves bought after Christmas do not grow as well as those bought before, and may not be ready for slaughter until late spring. It is thus best not to delay purchase too long.

It might be possible to delay yarding these animals the following autumn beyond the normal time, which seems to be mid-October. As this is a fairly intensive system, however, it is important to keep the cattle growing, particularly with Friesians. If the cattle were left on grass in the autumn and feed had to be carried out to them, no advantage would be gained, but on some farms it might be possible to rig up a self-service method to cover this crucial busy period.

The fourth column in the table for fattening cattle shows the normal inputs for single-suckled calves from weaning in autumn at 8 months until sold fat the following spring at 14 months.

The final column in Table 4 shows physical inputs for the 'barley beef' system from purchase of the calves at about 2 weeks old until slaughter.

Which of these particular systems will be chosen, apart from individual preference, depends on factors studied in subsequent chapters.

Chapter 3 Returns on Capital

Before embarking on any investment, it is obviously important to know whether a better return could be obtained by investing capital in some other project. When comparing beef cattle systems, however, there is the difficulty that they have production cycles of different lengths. Some give a quick return and some keep the farmer waiting a long time. If the profits from cattle were hoarded under the mattress, it would not matter whether the cash was available now or in several year's time. But if the farmer can reinvest his profits as he makes them, then the timing of the return becomes important.

One way of comparing cash returns at different dates is to discount them back to the starting point[1]. The discount rate used is the compound interest the investment would have earned in some alternative use. This is the Discounted Cash Flow method. The procedure used in this investigation was as follows:-

1) It was assumed that the farmer was prepared to invest £5,000 in beef production. This seemed enough to provide a worthwhile unit under a variety of systems.

2) It was assumed that no other livestock were kept on the farm and that straw was freely available. It was also assumed that the farmer had to buy equipment such as a baler, manure spreader and grain crusher to grow and prepare food for the cattle. This was paid for out of the £5,000 and amounted to £650 to £1,100 depending on the system. For unsupplemented grazing an allowance of £60 was made. It is important to bear in mind that these sums would be spent even if only a very small beef enterprise were contemplated.

3) Some farms have buildings already suitable for beef cattle or easily adapted for the purpose. On others, new buildings would be required. Both alternatives are considered. In the latter case, £20 was charged per mature beast and £15 per calf.

4) The capital cost included the purchase of the first batch of cattle and, if beef cows were to be kept for breeding, the entire cost of setting up the herd.

5) Variable costs such as food and medicines are also included in capital costs—up to the point when receipts begin to exceed current expenses.

6) The pattern of investment is thus as follows. First there is a large lump sum for equipment and the purchase of stock. This investment total then creeps slowly upwards as we add the cost of food and other items in the months that follow, reaching a peak just before the first cattle are sold. The peak capital requirement is the crucial factor, and it is assumed that the farmer cannot exceed the £5,000 allotted. For each system, therefore, the size of the enterprise is the one just large enough to absorb £5,000 at the peak.

7) We must now calculate the net returns from the enterprise. Once established the beef enterprise will, it is hoped, produce receipts each year and these less current costs give the net return or profit for that year. This net profit might be assumed to continue indefinitely. Circumstances, however, are liable to change and the time might come when the farmer wished to change to a different system or even to give up beef production altogether. It is prudent therefore to give the enterprise a definite life. This means that for the enterprise to 'pay', the farmer should not only make a profit each year but also make enough over this period to recover the capital sunk in buildings, equipment and permanent stock. It is thus assumed that the beef enterprise will be wound up and in the final year stock and equipment will be sold.

Buildings (which cannot be sold without selling the whole farm) are written off entirely. It is true that they could probably be put to other uses, but as adaptation might be expensive, it seems prudent to assign no value to them. The farmer will, of course, hope that the cattle will continue to pay for longer than the ten years assumed in this exercise. If so, this would provide an extra bonus over and above the returns shown here. But it would be unwise to count on such distant returns when assessing

[1] This means that if the interest rate is 10 per cent, then a profit of £100 in a year's time is worth only £91 now, and £100 in 5 year's time is worth only £62 now. The reason is that £62 invested now would (with interest) become £100 in five years. £62 is thus the discounted or net present value of £100 in five years time.

the feasibility of a proposed new venture. The long-term proceeds of a beef enterprise over a term of, say, ten years are thus:—

Initial costs of establishment ..		Annual receipts (10 years)* ..	
Annual costs (10 years)*		Proceeds of sale of stock	
Balance* = 10-year 'profit' ..		and equipment after 10 years ..	

*Discounted back to the initial date

In other words, the farmer has spent £5,000 on establishing the enterprise. Against this, he has set the annual surplusses of receipts over current costs and the proceeds expected from selling up the enterprise at the end of ten years (all discounted back to year 1). The amount by which the total proceeds exceed the £5,000 originally invested represents the net return over 10 years.

8) The final question is to decide the rate of interest to use for discounting. The rate chosen should be the one obtainable from the most profitable alternative use of the capital. Alternative rates have been used: five, ten and fifteen per cent. Five per cent might represent the return from fairly safe industrial shares and ten per cent the return if one adds an allowance for the greater risk as compared to a good equity. Finally, fifteen per cent can represent the average return to be expected from tenant's capital on the average farm.

There are, of course, many systems a farmer can adopt. He can start with calves that are pail fed, single-suckled or multiple-suckled. He can start with stores of varying sizes. He can purchase stock in autumn or spring. There is a similar variety in the finishing point. The farmer can keep stock for a few months or for over two years. He can sell in the autumn or spring and he can sell them as stores or fat. Of all the possible variations, 32 systems have been chosen because they are in use. To avoid a long description each time a system is mentioned, a simple code is used. (See Table 5).

Table 6 shows the net cash flows from an investment of £5,000 in beef cattle if standard performances and 1965/6 prices were obtained, either if buildings were already on the farm or had to be put up. In all cases, the system becomes 'established' by the end of the second year, so that, providing prices remain static, the return given in the column headed 'year 1 to n-1' would be realised every year except the first and last. Almost the only system giving a cash surplus in the first year is summer fattening of mature cattle, because hardly any equipment is required.

Table 7 gives the Net Present Value (N.P.V.) of these cash flows, discounted at 10 per cent. These N.P.V.'s provide a means of ranking the systems described in that a positive net present value shows a new rate of return to capital in excess of 10 per cent while a negative figure shows an internal rate of return less than 10 per cent. The return to capital is an important criterion of success. It is not, of course, the only one—others such as the return to labour or land will be given later.

The full system of classification is set out in Table 7 which also gives the total return (as cash flow discounted at 10 per cent) assuming that buildings are available[1]. The highest returns come from system No. 1 (£13,479), pail-fed calves reared to 3 months. Because the investment is only £26 per head, 692 calves can be reared with £5,000 (less cost of equipment). The tending of this number is, however, quite an onerous task with appreciable risk of disease and a reasonably large reward is to be expected. The margin per head is small and a check in progress of a drop in price could cut the profit substantially. System No. 2 (barley beef) gives less than half as much, £5,795, but is gained from the production of only 83 fat cattle. Both of these are continuous systems. Amongst the systems using autumn-born calves, the most profitable is No. 4, the production of stores at 14 months (£11,402), followed by No. 3, stores at 8 months (£9,129), and No. 7, fat cattle at 2 years (£8,269).

Spring-born, pail-fed calves are somewhat less profitable. The best systems are No. 8, stores sold at 8 months (£8,324), and No. 9, stores at 14 months (£7,603). Amongst single-suckled calves No. 16, sold fat at 14 months, is best (£6,190) followed by No. 14, stores at the same age (£5,764). Amongst

[1] Other alternatives—5 per cent and 15 per cent interest for enterprises lasting 5 or 10 years—are given in Appendix A.

multiple-suckled calves (reared all the year round) the best are No. 19, sold as stores at 14 months (£6,736) and No. 21, sold fat at 24 months (£6,620).

The purchase of small, 8-month stores appears less profitable than calves but involves less responsibility. The best (£5,986) appears to be No. 25, spring-purchased and sold six months later. The least profitable are small stores wintered for 6 months, Nos 22 and 24.

The remaining systems deal with the purchase of larger stores. On the whole they are less profitable than the young stock. The best is No. 29 (£2,671) for autumn-bought stores kept for 10 months, followed closely by Nos. 28 and 32, stores kept for the summer. Two traditional systems of wintering stores, Nos. 27 and 31, have negative returns. They are obviously kept for some motive other than profit e.g. the procuring of farmyard manure for root crops.

So far we have assumed that buildings are available. If buildings have to be erected and paid for by the cattle, the picture is somewhat different. Nearly all show a substantial loss in profit margins—except for summered stores that need no buildings. On the whole, however, the order of preference is not much changed.

It has also been assumed so far that the present staff can handle the new enterprise at no extra cost. On many farms this is a reasonable supposition. Some of the cattle enterprises described are, however, quite large and extra labour might be required. If so, it is necessary to provide an extra stockman for the whole year. His wage was deducted from each of the net cash flows already given in Table 6 and the resultant figures were discounted. The discounted wage over 10 years is £6,081 and if this is deducted from the profit margins quoted, very little is left. With buildings available, only nine systems, namely Nos. 1, 3, 4, 7, 8, 9, 16, 19, and 21, show any profit. These are all calf-rearing systems. None of the store systems show any surplus. If the cattle had to pay both for buildings and a stockman, only two systems, Nos. 1 and 4, show a surplus. It might, of course, be possible to justify a full-time stockman if there were some other enterprise e.g. pigs or cows, on which he could also be employed. Otherwise, it is hard to justify his employment on this scale.

Table 5 List of Systems Described

System No.	*Code*	*System*
1	PF–S3	Pail-fed, sold as 3-month store, born or purchased all year round.
2	PF–F12	Pail-fed, sold as 12-month fat, born or purchased all year round.
3	PF(A)–S8	Pail-fed, sold as 8-month store, born in autumn.
4	PF(A)–S14	Pail-fed, sold as 14-month store, born in autumn.
5	PF(A)–S20	Pail-fed, sold as 20-month store, born in autumn.
6	PF(A)–F18	Pail-fed, sold as 18-month fat, born in autumn.
7	PF(A)–F24	Pail-fed, sold as 24-month fat, born in autumn.
8	PF(S)–S8	Pail-fed, sold as 8-month store, born in spring.
9	PF(S)–S14	Pail-fed, sold as 14-month store, born in spring.
10	PF(S)–S20	Pail-fed, sold as 20-month store, born in spring.
11	PF(S)–F12	Pail-fed, sold as 12-month fat, born in spring.
12	PF(S)–F24	Pail-fed, sold as 24-month fat, born in spring.
13	SS–S8	Single-suckling calf, sold as 8-month store.
14	SS–S14	Single-suckling calf, sold as 14-month store.
15	SS–S20	Single-suckling calf, sold as 20-month store.
16	SS–F14	Single-suckling calf, sold as 14-month fat.
17	SS–F24	Single-suckling calf, sold as 24-month fat.
18	MS–S8	Multiple-suckled calf, sold as 8-month store, born or purchased all year round.
19	MS–S14	Multiple-suckled calf, sold as 14-month store, born or purchased all year round.
20	MS–S20	Multiple-suckled calf, sold as 20-month store, born or purchased all year round.
21	MS–F24	Multiple-suckled calf, sold as 24-month fat, born or purchased all year round.
22	S8(A)–S14	8-month store, sold as 14-month store, purchased in autumn.
23	S8(A)–S20	8-month store, sold as 20-month store, purchased in autumn.
24	WSS(A)–F14	Single-suckled calves weaned in autumn, sold 14-month fat.
25	S8(S)–S14	8-month store, sold as 14-month store, purchased in spring.
26	S8(S)–S20	8-month store, sold as 20-month store, purchased in spring.
27	S14(A)–S20	14-month store, sold as 20-month store, purchased in autumn.
28	S14(S)–S20	14-month store, sold as 20-month store, purchased spring.
29	S20(A)–F30	20-month store, sold as 30-month fat, purchased autumn.
30	S20(S)–F30	20-month store, sold as 30-month fat, purchased spring.
31	S24(A)–F30	24-month store, sold as 30-month fat, purchased autumn.
32	S24(S)–F30	24-month store, sold as 30-month fat, purchased spring.

Table 6 NET CASH FLOWS GENERATED BY INVESTING £5,000 IN A BEEF ENTERPRISE

	System		Total Machinery and Equipment	Remaining from £5,000	Building already on farm: Peak Capital per head	Building already on farm: Number of animals sold/ annum	Building already on farm: Net Cash Flows: Year 0 (first year)	Building already on farm: Net Cash Flows: Year 1 to n-1 (intermediate years)	Building already on farm: Net Cash Flows: Year n (final year)	Including new buildings: Peak Capital per head	Including new buildings: Number of animals sold/ annum	Including new buildings: Net Cash Flows: Year 0 (first year)	Including new buildings: Net Cash Flows: Year 1 to n-1 (intermediate years)	Including new buildings: Net Cash Flows: Year n (final year)
			£	£	£		£	£	£	£		£	£	£
1.	PF–S3		500	4,500	26·0	692	1,576	2,067	2,067	41·0	436	—827	1,299	1,299
2.	PF–F12	(continuous)	1,020	3,980	48·0	83	—3,175	1,372	3,892	66·0	60	—3,615	983	2,783
3.	PF(A)–S8		650	4,350	36·4	119	813	1,444	1,444	51·4	84	—875	1,013	1,013
4.	PF(A)–S14		710	4,290	44·8	95	1,019	1,803	1,803	59·8	71	—483	1,342	1,342
5.	PF(A)–S20		1,100	3,900	83·4	46	—2,747	813	3,297	118·4	32	—3,654	556	2,284
6.	PF(A)–F18		1,100	3,900	89·7	43	—2,596	1,309	3,631	124·7	31	—3,264	934	2,608
7.	PF(A)–F24		1,100	3,900	94·5	41	—2,633	1,730	3,944	124·5	31	—3,189	1,300	2,974
8.	PF(S)–S8		650	4,350	36·4	119	694	1,325	1,325	51·4	84	—959	929	929
9.	PF(S)–S14		1,080	3,920	47·7	82	232	1,280	1,280	67·7	57	—1,821	880	880
10.	PF(S)–S20		1,080	3,920	80·2	48	—1,954	986	3,578	100·2	39	—3,447	795	2,901
11.	PF(S)–F12	(one batch)	1,020	3,980	65·1	61	11	1,031	1,031	85·1	47	—1,166	794	794
12.	PF(S)–F24		1,100	3,900	109·4	35	—2,493	1,122	3,040	149·4	26	—3,175	825	2,250
13.	SS–S8	(cows in)	1,080	3,920	98·5	39	—2,893	1,181	3,911	118·5	33	—3,274	994	3,304
		(cows out)	1,080	3,920	98·5	39	—2,893	1,181	3,911	98·5	39	—2,893	1,181	3,911
14.	SS–S14	(cows in)	1,080	3,920	109·8	35	—2,508	1,256	3,706	149·8	26	—3,181	925	2,745
		(cows out)	1,080	3,920	109·8	35	—2,508	1,256	3,706	129·8	30	—2,904	1,072	3,172
15.	SS–S20	(cows in)	1,080	3,920	126·9	30	—3,087	1,069	4,789	166·9	23	—3,287	812	3,664
		(cows out)	1,080	3,920	126·9	30	—3,087	1,069	4,789	146·9	26	—3,195	922	4,146
16.	SS–F14	(cows in)	1,080	3,920	110·5	35	—2,445	1,319	3,769	155·5	25	—3,180	933	2,683
		(cows out)	1,080	3,920	110·5	35	—2,445	1,319	3,769	135·5	29	—2,897	1,165	3,335
17.	SS–F24	(cows in)	1,100	3,900	157·0	24	—3,572	1,129	2,809	227·0	17	—4,041	790	1,980
		(cows out)	1,100	3,900	157·0	24	—3,572	1,129	2,809	207·0	19	—3,817	887	2,217
18.	MS–S8		1,100	3,900	47·6	[1]78	—1,147	1,108	2,408	60·6	[1]60	—1,916	819	1,819
19.	MS–S14		1,100	3,900	52·9	[1]72	—2,951	1,493	4,061	75·9	[1]48	—3,437	985	2,597
20.	MS–S20		1,100	3,900	74·1	[1]48	—3,687	1,085	4,093	107·1	[1]36	—4,228	806	3,062
21.	MS–F24		1,080	3,920	107·1	36	—2,887	1,440	4,302	142·1	24	—3,125	928	2,836
22.	S8(A)–S14		1,020	3,980	49·3	80	—580	409	409	69·3	57	—1,846	282	282
23.	S8(A)–S20		1,080	3,920	54·4	72	—461	731	731	74·4	52	—1,673	519	519
24.	WSS(A)–F14		1,020	3,980	64·0	62	—555	434	434	79·0	50	—1,295	344	344
25.	S8(S)–S14		60	4,940	46·4	106	746	910	910	46·4	106	746	910	910
26.	S8(S)–S20		1,080	3,920	57·6	68	—618	530	530	77·6	50	—1,740	390	390
27.	S14(A)–S20		1,020	3,980	65·2	61	all negative at present prices			85·2	46	all negative at present prices		
28.	S14(S)–S20		60	4,940	59·9	82	194	416	416	59·9	82	194	416	416
29.	S20(A)–F30		1,080	3,920	81·0	48	—600	568	568	96·0	40	—1,280	468	468
30.	S20(S)–F30		1,080	3,920	87·3	44	—834	302	302	107·9	36	—1,598	242	242
31.	S24(A)–F30		1,020	3,980	93·8	42	all negative at present prices			113·8	35	all negative at present prices		
32.	S24(S)–F30		60	4,940	86·3	57	208	408	408	86·3	57	208	408	408

[1] Multiples of 6 only, as 6 calves reared per cow.

Table 7 Net Present Value of Alternative Investments

(Discounted at 10%)

System		*Finished as —*	*Buildings Available*	*New Buildings charged*
Pail-fed calves:			£	£
1. PF–S3		3m Calves	13,479	6,653
2. PF–F12		12m Fat	5,795	2,809
3. PF(A)–S8		8m Stores	9,129	4,959
4. PF(A)–S14		14m Stores	11,402	7,245
5. PF(A)–S20		20m Stores	2,988	280
6. PF(A)–F18		18m Fat	5,927	2,825
7. PF(A)–F24		24m Fat	8,269	5,008
8. PF(S)–S8		8m Stores	8,324	4,391
9. PF(S)–S14		14m Stores	7,603	3,247
10. PF(S)–S20		20m Stores	4,823	2,024
11. PF(S)–F12	(1 batch)	12m Fat	5,948	3,407
12. PF(S)–F24		24m Fat	4,782	2,180
Singled-suckled calves:				
13. SS–S8	(cows in)	8m Stores	5,066	3,430
	(cows out)[1]		5,066	5,066
14. SS–S14	(cows in)	14m Stores	5,764	2,917
	(cows out)[1]		5,764	4,160
15. SS–S20	(cows in)	20m Stores	4,647	2,598
	(cows out)[1]		4,647	3,482
16. SS–F14	(cows in)	14m Fat	6,190	2,935
	(cows out)[1]		6,190	4,733
17. SS–F24	(cows in)	24m Fat	3,642	1,013
	(cows out)[1]		3,642	1,855
Multiple-suckled calves				
18. MS–S8		8m Stores	5,785	3,224
19. MS–S14		14m Stores	6,736	2,919
20. MS–S20		20m Stores	3,837	1,370
21. MS–F24		24m Fat	6,620	3,028
Small Stores:				
22. S8(A)–S14		14m Stores	1,775	—221
23. S8(A)–S20		20m Stores	3,748	1,315
24. WSS(A)–F14		14m Fat	1,944	586
25. S8(S)–S14		14m Stores	5,986	5,986
26. S8(S)–S20		20m Stores	2,434	506
27. S14(A)–S20		20m Stores	negative	negative
28. S14(S)–S20		20m Stores	2,589	2,589
Large Stores:				
29. S20(A)–F30		30m Fat	2,671	1,415
30. S20(S)–F30		30m Fat	905	—204
31. S24(A)–F30		30m Fat	negative	negative
32. S24(S)–F30		30m Fat	2,558	2,558

[1] Single-suckling cows are out-wintered where reasonable shelter is available, and where severe poachinng will ot occur.

Chapter 4 Fitting the System to the Individual Farm

If capital were the only factor limiting the size of the beef enterprise, then the best system would be the most profitable one shown in the previous chapter. In practice, however, the farmer may have enough capital but be short of labour, land or housing. In other words, the critical criterion may be the return per hour, per acre or per square yard of accommodation. The amount of labour, land and housing used by each system is given in Appendix B. The return in the form of Gross Margin[1] per hour per acre or per square yard is given in Table 8. If labour is short, the season of the year at which labour is required for cattle may be crucial. The five time periods chosen are those in which labour bottlenecks are liable to occur. Early spring includes cereal sowing in March and April; late spring and early summer includes sugar beet thinning, inter-row cultivations and hay making, from May to early July; late summer and early autumn—late July, August and September—includes the cereal harvest; and late autumn, October and November, includes the root harvests and sowing of autumn cereals; winter is from December to February.

The figures show, for each system, the gross margin per hour spent on tending cattle and growing forage crops.

Before discussing the table, it may be as well to note some pitfalls. Taking the column for Gross Margin per hour of total labour, it will be seen that forward stores bought in spring to fatten off grass (No. 32) give a gross margin of £1·80 whereas weaned single-sucklers fattened over winter (No. 24) only give 30p per hour. At first sight it might seem that the former justifies more labour, whereas the latter does not because the return hardly covers labour costs. In fact, a system with a low return per hour may be using labour when there is little else for the man to do. It is thus obvious that an attempt to judge beef enterprises solely on the return per man hour worked can be misleading.

A comment on gross margins per forage acre may be useful at this point. It is usually stated that beef cattle should not use resources which can be used more profitably by other enterprises. In most cases the gross margin per acre used by the cattle is much lower than from cash cropping. This implies that land which can grow good cash crops should be so used and that beef cattle should be confined to land not suitable for that purpose. But if the beef cattle are to use permanent pasture, they must be allowed some arable land for fodder crops, even if the return per acre is fairly low[2].

On the other hand, very intensive systems, such as PF–F12 (No. 2) and PF(A)–S8 (No. 3), show a very high gross margin per forage acre because they use hardly any land. Indeed, the land may represent only the small amount of hay used and if this were purchased, these systems would need no land whatever. Forage acres do not, of course, include home-grown cereals because these are treated as cash crops. Grain used by beef cattle is thus 'sold' by the farm to the beef enterprise.

We can now return to the use which can be made of Table 8, and in the main will be discussing each system in the order it appears.

It can be seen that no one system of beef production gives simultaneously the highest returns for each of the resources of labour, land and accommodation. If it did, then no matter what combination of inputs were available, that system would be the most profitable on any farm. We can, of course, ignore the two systems—S24(A)–F30 (No. 31) and S14(A)–S20 (No. 27)—which give negative gross margins. As stated earlier in this report, it is difficult to visualise circumstances in which these systems would prove as useful as other alternatives. The following is a brief comment on where these systems might best fit into the farming system.

PF–S3 (No. 1) With the right type of labour, calves can be reared to sell to other producers who prefer to purchase animals past the difficult stage. Returns per hour of labour are not high but returns

[1] Gross Margin=(Sales and subsidies+closing valuations)—(opening valuations and/or purchase price of animals and price paid for purchased feed, sale value of home-grown cereals, variable cost of growing other home-grown feeds+other variable costs, such as transport and vet.).

[2] See chapter 4 in 'The Economic Position of Sheep in the Eastern Counties', B. G. Jackson. Mimeographed Report No. 62.

to housing are good. As the feed is purchased, no land is required. Not being tied to acreage and requiring labour all the year round, such a unit can be expanded to give full-time employment, provided that 50p per hour is regarded as adequate to pay wages and leave a margin of profit. The risky nature of the enterprise has been pointed out in Chapter 3.

PF–F12 continuous (No. 2) Where housing is available, a more profitable use of the man's time would be made by finishing the calves as baby beef. Although a gross margin per forage acre is quoted, this is for hay only, which could be purchased. This system can therefore expand regardless of acreage[1]. Not being tied to acreage, and being capable of continuous operation, a full-time man can be employed. In this case, it is relevant to look at returns per hour of total labour. As this is 80p, it is worth employing labour specifically on this project. The early rearing period is the most time consuming. For this reason, the stockman can handle more cattle if the calves come in batches at regular intervals. It is an ideal system for a cash-cropping farm where all the land is ploughable and grass need not be included in the rotation.

PF(S)–F12 (No. 11) As an alternative to continuous barley beef production and a full-time stockman, the farmer can buy calves in spring only. This implies the part-time use of workers drawn from other tasks. This system gives the highest return of any for autumn labour when there is a 'bottleneck' on arable farms. Calves bought in spring cost more than those bought in autumn but this is offset by the higher price for the stock sold.

PF(A)–S8 (No. 3) Purchasing calves in the autumn is the basis of the next system appearing in the tables. Rearing them for sale in the following spring is a good system for any farm having a tight work schedule in late spring, as might happen on a cash root farm where casual labour for hoeing is difficult to obtain. Again, it is a system suitable for an arable farm, as virtually no land is required.

PF(A)–S14 (No. 4) Where some clean grazing is available, the calves can be carried on and sold as stores in the autumn. The returns per acre indicate that it would not be unprofitable to take the necessary area out of corn production to provide the grass. This is a useful system where accommodation is limited.

PF(A)–F18 (No. 6) Autumn calves sold fat in spring at 18 months. This semi-intensive fattening system is probably most useful for a corn and grass farm where cereal harvest is still the busiest time, and where the acreage is not large enough for low returns per acre to be acceptable. Again, there would be little loss of income if some corn growing was sacrificed in order to grow clean leys for these cattle.

PF(A)–F24 (No. 7) Autumn calves sold fat at two years. Suitable for farms having a peak labour demand in late summer and early autumn, where housing is limited, but having some unploughable grassland suitable for fattening.

PF(S)–S8 (No. 8) Spring born calves sold in the autumn. A useful system where there is an autumn peak in labour demand and there is not enough housing for the otherwise better system of fattening the calves to barley beef. Where an outdoor rearing system could be adopted, it could be made lucrative, and permanent housing would not be needed.

SS–S14 and SS–F14 (Nos. 14 and 16) Single-suckling calves. Herds of beef cows provide a means of utilising unploughable grassland. The return per acre is, of course, less than for dairy cows or cash crops. Beef cows are useful on a large corn and grass farm because they require very little attention when the staff is busy with the corn harvest. If the cows can be outwintered and the calves are sold in autumn, very little housing is required. If housing is available, it would be more profitable to retain as many calves as possible to sell fat at 14 months old.

[1] Gross margins would be reduced by about £4 per beast if all barley had to be bought rather than home grown, and by about £2 for the extra cost of purchased hay, plus another £2 at least if bedding material had to be bought. Therefore the large arable farmer has a considerable advantage over the other producers

Table 8 GROSS MARGIN PER UNIT OF LABOUR, LAND AND ACCOMMODATION

System	Return to Labour — Competing Uses of Labour: Drilling, Early Spring £ per hour	Root Singling and Hay, Late Spring £ per hour	Cereal Harvest, Early Autumn £ per hour	Root Harvest, Late Autumn £ per hour	(includes application of F.Y.M.) Winter £ per hour	Overall £ per hour	Return to Land Forage acres £ per acre	Return to Housing £ per sq. yd.
1. PF–S3	3·0	2·0	3·0	3·0	1·7	0·5	N.R.	10·1
2. PF–F12 (continuous)	5·6	3·0	6·0	6·0	2·3	0·8	84·5	3·1
3. PF(A)–S8	3·6	12·3	6·2	3·5	2·0	0·8	123·0	4·4
4. PF(A)–S14	4·8	5·3	5·6	3·8	3·2	0·9	38·4	6·8
5. PF(A)–S20	2·1	3·3	5·4	2·4	1·2	0·4	23·0	2·2
6. PF(A)–F18	2·8	4·2	17·3	2·7	1·9	0·6	31·2	3·3
7. PF(A)–F24	4·4	4·0	10·2	3·9	2·4	0·8	24·0	5·2
8. PF(S)–S8	3·0	1·9	3·3	6·6	11·3	0·7	113·0	4·0
9. PF(S)–S14	1·6	1·5	4·7	2·0	1·5	0·4	40·0	2·9
10. PF(S)–S20	1·9	1·8	5·3	2·6	1·9	0·5	17·7	3·9
11. PF(S)–F12 (one batch)	2·7	3·1	8·5	8·5	2·8	0·8	84·5	3·1
12. PF(S)–F24	2·4	1·7	8·3	1·6	1·3	0·4	21·0	2·4
13. SS–S8	4·4	2·8	15·6	2·8	3·3 or 2·6[2]	0·8 or 0·7[2]	13·5	N.R. or 2·8[2]
14. SS–S14	3·2	2·3	18·4	2·0	1·9 or 1·7	0·6 or 0·5	13·6	6·7 or 2·2
15. SS–S20	2·9	2·1	14·1	2·0	1·9 or 1·7	0·5	10·5	6·7 or 2·2
16. SS–F14	3·5	2·1	19·3	2·0	2·2 or 1·9	0·5	14·8	7·0 or 2·3
17. SS–F24	2·8	1·9	18·6	1·7	1·4 or 1·3	0·4	12·4	3·5 or 2·0
18. MS–S8	2·3	1·9	4·4	2·2	1·1	0·4	28·4	3·6
19. MS–S14	2·5	1·9	5·6	2·1	1·2	0·4	23·5	3·2
20. MS–S20	2·1	1·5	5·5	1·6	1·0	0·3	15·5	2·3
21. MS–F24	2·6	2·1	8·7	1·9	1·3	0·4	18·0	3·8
22. S8(A)–S14	1·2	1·2	N.R.	0·8	0·6	0·2	13·8	1·0
23. S8(A)–S20	1·7	2·0	17·7	1·4	1·1	0·4	8·8	1·9
24. WSS(A)–F14	1·7	1·4	N.R.	0·8	0·8	0·3	25·0	1·4
25. S8(S)-S14	9·5	3·6	6·6	6·6	N.R.	1·5	17·2	N.R.
26. S8(S)–S20	1·7	1·8	6·0	1·5	0·8	0·3	9·7	1·2
27. S14(A)–S20				all negative at present prices				
28. S14(S)–S20	2·7	5·7	8·5	7·3	N.R.	1·2	5·7	N.R.
29. S20(A)–F30	2·5	1·7	17·8	1·5	1·1	0·4	9·0	2·3
30. S20(S)–F30	1·9	0·9	9·5	0·6	0·5	0·2	6·3	0·9
31. S24(A)–F30				all negative at present prices				
32. S24(S)–F30	6·0	3·3	12·0	N.R.	N.R.	1·8	7·2	N.R.

(1) Labour includes time spent on growing fodder crops—silage before New Year, mangolds after.
(2) Where two figures are given, the higher figures are where it is possible to out-winter single-suckling cows.
(3) N.R. None of this resource is required (this is equivalent to a very high return).

MS–S14 and MS–F24 (Nos. 19 and 21) Multiple-suckling calves. In theory, multiple-suckling makes better use of the cow than single-suckling. It does, however, require substantially more labour and individual attention. The return on capital is reasonably good but no better than a single-suckled herd.

S8(S)–S14 (No. 25) Eight month calves bought in spring and sold in the autumn. This may be useful where no buildings are available, provided the grazing is suitable for beasts of this age; it gives a higher return per forage acre than any other system not requiring housing.

S14(S)–S20 (No. 28) and S24(S)–F30 (No. 32) Summer fattening of stores. Relatively trouble-free methods of using permanent grass where cattle cannot be retained through the winter. Where the pastures are suitable, the fattening method is best. In East Anglia it is normal practice to fatten only one batch each year as being a dry area there is often a period in late summer when little or no growth of grass occurs. This means that the cattle are off the farm before root harvesting begins. On a farm with permanent pasture, and a shortage of labour in autumn, it may be the best system to adopt.

Although the type of farm on which different systems would be suitable has been discussed, a clear-cut way of finding the most profitable method has yet to be shown. This would be simple on a farm where one resource was obviously the limiting factor because it would only be necessary to look at the column dealing with that factor and pick the enterprise with the highest return. If, for example, labour at spring drilling was the only factor limiting output, the system chosen would be S8(S)–S14. In practice, although the resources in short supply can usually be guessed, it is difficult to be precise.

The only method is to make an estimate with the aid of Appendix B. Labour hours are here divided into direct work on stock and the provision of forage, because the work may be done by different workers. The first step is to decide how much of each of the twelve factors given in the table are available for beef production on the farm in question, and to write these down in the order given across the page.

To save having to consider all the systems, it should be possible to decide which resources are in short supply, and to pick from Table 8 systems that give high returns to these factors. For example, on a farm where accommodation is the most obvious limitation, only methods giving more than £4 per square yard of housing need to be considered.

Of course, if one input is not available at all, this narrows the choice to systems that do not use that input. For example, if there is no housing, then only the four methods using no housing are feasible, and one of these is possible only if the single-suckling cows can be outwintered.

Having written down the hours, acres and accommodation available, and decided on the most likely systems, arithmetic will show which method to adopt.

For each system studied, inputs available on the farm are divided by the amount required per head for that system. The lowest number obtained indicates the limiting factor and the number of cattle that can be kept. This multiplied by the gross margin per head gives the total gross margin obtainable with that system. By comparing all the likely systems, the one giving the highest gross margin can be found. Normally labour is a restriction at only one period of the year. In consequence, it is only for that period that we need calculate the hours available. Having found the best system to adopt, a quick check can be made to find whether it is feasible at the size shown with regard to the other factors.

Example—For a farm with the least labour to spare in late autumn, plenty of time available at other seasons.

RESOURCES AVAILABLE ON FARM FOR BEEF CATTLE

Man Hours during Late Autumn (October-November)		*Forage Acres*	*Accommodation*
Direct	*Forage*		
120 hrs	90 hrs	20 acres	300 sq. yds.

For this farm those giving a high return on autumn labour, acreage and housing need to be considered.

From Table 8 these are shown to be:

PF–S3
PF–F12 (continuous)
PF(A)–S8
PF(A)–S14
PF(A)–F18
PF(A)–F24
PF(S)–S8
PF(S)–F12

Taking these in turn, and dividing the resources available by the requirements for each, the maximum Gross Margin is found.

	Man hours Oct.–Nov.		*Forage Acres*	*Accommodation*
PF–S3	*Direct*	*Forage*	*Total*	*sq. yds.*
Available	120	90	20	300
divided by Required/head	1	0	0	0·3
No. of animals =	120			1000
	PF–S3=120 x £3=**£360 Gross Margin**			
PF-F12 (continuous)				
Available	120	90	20	300
divided by Required/head	2·8	0	0·2	5·5
No. of animals =	43		100	54
	PF–F12 (continuous)=43 x £16·9=**£727 Gross Margin**			
PF(A)–S8				
Available	120	90	20	300
divided by Required/head	3·5	0	0·1	2·8
No. of animals =	34		200	107
	PF(A)–S8=34 x £12·3=**£418 Gross Margin**			
PF(A)–S14				
Available	120	90	20	300
divided by Required/head	40	1·0	0·5	2·8
No. of animals =	30	90	40	107
	PF(A)–S14=30 x £19·2=**£576 Gross Margin**			
PF(A)–F18				
Available	120	90	20	300
divided by Required/head	8·2	3·3	1·0	9·4
No. of animals =	14	27	20	31
	PF(A)–F18=14 x £31·2=**£437 Gross Margin**			

	Man hours Oct.-Nov. *Direct*	*Forage*	*Forage Acres* *Total*	*Accommodation* *sq. yds.*
PF(A)–F24				
Available divided by	120	90	20	300
Required/head	6·3	4·6	1·8	8·3
No. of animals =	19	19	11	36
	PF(A)–F24=11 x £43=**£473 Gross Margin**			
PF(S)–S8				
Available divided by	120	90	20	300
Required/head	1·7	0	0·1	2·8
No. of animals =	70		200	107
	PF(S)–S8=70 x £11·3=**£791 Gross Margin**			
PF(S)–F12				
Available divided by	120	90	20	300
Required/head	2·0	0	0·2	5·5
No. of animals =	60		100	54
	PF(S)–F12=54 x £16·9=**£913 Gross Margin**			

For this particular farm the best method would be to buy a batch of 54 calves in the spring for sale fat twelve months old, on the intensive barley beef system.

The actual gross margin obtained in practice will agree with the amount calculated only if the farmer has the same average standards of efficiency and prices as are assumed. If he is more efficient or gets higher prices, he will make more, and if less efficient he will make less. But this would probably also apply to any of the alternatives. For this reason, the comparisons between the systems are still likely to be valid.

More accurate results would be obtained if data are available for the farm in question. But if they are not, the estimates in the tables give a reasonable guide as to the system of beef production most suitable for any individual farm.

Chapter 5 Selecting the Beef Herd to Suit the Farm

AN EXERCISE IN COMPUTER PROGRAMMING

The aim of this chapter is to show how a beef enterprise can be fitted into the economy of a mixed farm. In hill farming, cattle may be the dominant enterprise, but this is not one of the possibilities considered here. On mixed farms cattle are usually a minor and often not very profitable enterprise. For this reason, it is the cattle that must be fitted to the farm plan and not the farm to the cattle. It was thus considered more realistic to take certain farm types as given and show which type of beef enterprise would best suit them.

The three farm types chosen were of 200 acres. The first, Farm A, was a 'typical' East Anglian cash crop farm (1); the second, Farm B, was based on an optimum cropping plan described by Barnard and Weston (2) and was again mainly cropping; the third, Farm C, was a corn and grass farm more typical of the Midlands and West of England than of East Anglia. Two sizes of housing were assumed for each farm. A small one (250 sq. yds) which is definitely limiting; and a large one (2,500 sq. yds.) which allows full scope for any cattle system that can be fitted into the farm plan. For labour, the two assumptions were either (a) part-time help from existing field staff, or (b) an extra full-time stockman.

Farm Types for which Maximum Profit from Beef Plans were Computerised

Farm A
1. Wheat 45 acres, Barley 76 acres, Sugar Beet 20 acres, Forage 55 acres, Waste, roads, etc. 4 acres=200 acres.
   Labour 3 men. Accommodation 250 sq. yds.
2. Accommodation increased to 2,500 sq. yds.
3. Labour increased to 4 men.
4. Accommodation increased to 2,500 sq. yds. and labour to 4 men.

Farm B
1. Wheat 50 acres, Barley 100 acres, Sugar Beet 20 acres, Potatoes 20 acres, Forage 6 acres, Waste, roads, etc. 4 acres=200 acres.
   Labour 5 men. Accommodation 250 sq. yds.
2. Accommodation increased to 2,500 sq. yds.

Farm C
1. Barley or mixed corn 50 acres, Forage 146 acres, Waste, roads, etc. 4 acres=200 acres.
   Labour 2 men. Accommodation 250 sq. yds.
   Livestock: beef cattle and/or sheep.
2. Accommodation increased to 2,500 sq. yds.
3. Accommodation 250 sq. yds., labour increased to 3 men.
4. Accommodation 2,500 sq. yds., labour increased to 3 men.

All land not under cash cropping, roads, waste or buildings was assumed to be available for beef cattle, or beef and sheep on Farm C. Most of this would be grass, but it was assumed that fodder roots could be grown if the plan required them.

Labour for cash crops was a first priority and their requirements were deducted from the total man-days available in each season from the staff employed. The remaining man-days were then available for beef cattle and (if required) for sheep.

The forage crops in each plan were those that gave rise to the most profitable plan. The choices were as follows. Grass silage could be fed before New Year and either mangolds or grass silage thereafter. If sugar beet was grown, the tops could be fed before New Year and if potatoes were grown, chat potatoes could be fed afterwards. Silage has the advantage of freeing labour in the autumn, but needs more acres than do root crops to produce a given amount of nutrients. Kale was not included

because it either costs more or gives less nutrients per acre than other fodder crops. For this reason, it would not have appeared in any plan. Where insufficient grain or straw was grown, it was assumed that it could be purchased.

Table 9 shows the optimum systems for each farm and the optimum number of cattle to be reared. The optimum solution selected by the computer may, of course, include cattle kept on two or more systems. Some of the solutions, as stated, are unnecessarily complicated but could in practice be streamlined into a practical solution. For Farm B.1, the purchase of 530 pail-fed calves for sale at three months is the obvious solution and the small numbers on three other systems could be safely ignored or added to the main system. Farm A.2 looks complicated with six systems but, in fact, this could be rationalised into continuous rearing of calves with a possible peak of spring-born calves. The purchase of mature stores might be added if convenient.

Farm A, with wheat, barley, sugar beet and over a quarter of the farm available for cattle, requires systems that are economical with autumn labour.

Table 9 Systems and Numbers of Cattle (and Sheep) to give Maximum Gross Margins for each Farm Type

System		*Number of Cattle to be sold per Annum*									
		Farm A				*Farm B*		*Farm C*			
No.		1	2	3	4	1	2	1	2	3	4
1. PF–S3		144		787		526	531	99		753	
2. PF–F12	(continuous)		28		27				7		10
3. PF(A)–S8					53						
4. PF(A)–S14								78	119	9	217
7. PF(A)–F24		25	12	2	3				5		
8. PF(S)–S8			79		209						67
11. PF(S)–F12	(one batch)		40		25	2	13				
25. S8(S)–S14								156	129	173	34
32. S24(S)–F30		9		52							
5. PF(A)–S20			1		14	6					
27. S14(A)–S20			26			5	11				
Sheep								52 ewes		136 ewes	

Table 10 Total Gross Margins from Beef (and Sheep) for each Farm Type

	Farm A £	*Farm B* £	*Farm C* £
Basic	1 1,595	1 1,742	1 3,494
More Housing	2 2,553	2 1,819	2 3,665
More Labour	3 2,808		3 4,603
More Housing and Labour ..	4 4,222		4 5,117

On farms A.1 and A.3 with limited accommodation, the systems chosen give a high return to housing. On A.1, however, with only part-time help for cattle, some return on housing has to be sacrified to make the best use of time during root harvest. System No. 1 (PF–S3, pail-fed calves sold at 3 months) makes profitable use of housing, but does not give such high returns to labour, even in autumn, as system No. 7 (PF(A)–F24) autumn calves fattened to 24 months. Grazing, surplus to the requirements of system No. 7, is used by bought-in forward stores that need no housing and no autumn labour.

On A.3, with a full-time stockman, the return on housing overrides other considerations. As a result, self-rearing is dominant, the grazing being used by animals that need no housing.

On A.2 and A.4, with ample housing, systems selected give a high return to autumn labour. With a full-time stockman plus part-time help, more emphasis is given to improving returns from the forage acreage. On arable farms with a fairly high proportion of grass, it is profitable to use grass silage rather

than mangolds or sugar beet tops. Time in autumn is so valuable that it does not pay to divert it to save tops or harvest mangolds. Moreover, if the beef enterprise is large enough to use all the grain grown on the farm it would pay to sell young stores rather than buy grain and fatten them on a high concentrate diet. It does, however, pay to buy straw when required. The results recommended the purchase of 15 tons of straw on farm A.2 and 41 tons for farm A.4, and this on farms with well over 100 tons of home-grown straw available. It would be well worth taking on a full-time stockman on this type of farm, especially where ample cattle housing is available.

On farm B, with little land for cattle, the systems chosen give a high return to forage acreage. The predominant system is thus again calf rearing to 3 months. This is also true for B.2 where there is plenty of accommodation. An extra £800 gross margin could be gained by purchasing hay so that the calves could be retained, about half being sold fat at 12 months and half sold as young stores. On this type of farm, where forage acreage limits the system of beef enterprise very drastically, it would pay to buy grain to fatten baby beef. All the available chat potatoes are used to replace mangolds. But even with a limited area of forage it is still not worth using valuable autumn labour to save beet tops.

Leaving the corn and root farms with their relatively small grass acreage and autumn labour peak, we turn to the grass and corn C[1]. This has a tight work schedule at cereal harvest, and another busy period in early spring. In this case sheep (in the form of a breeding flock producing heavy late fat lambs) were allowed to compete with cattle for the available fixed resources. On C.1 and C.3, with limited accommodation, the systems chosen gave high returns to housing (No. 1 PF–S3 and No. 4 PF(A)–S14) or use no housing (No. 25, S8(S)–S14) on farm C.3, with an extra man returns per hour of labour during the grain harvest are less important, and do not prevent the optimum use of housing. As time is less important than on arable farms with limited accommodation (farms A.1 and A.3) the opportunity to get better gross margins on the forage acreage can be taken, by using the system S8(S)–S14 rather than the fattening system S24(S)–F30. When housing is increased (farms C.2 and C.4) systems giving low returns on labour and acreage to make the best use of housing are no longer necessary. Thus calf rearing, PF–S3, and sheep can be dropped and system PF(S)–S14 increased, the surplus grazing being used by purchasing reared calves of 8 months in the spring, as before.

On C.4, with an extra man, better use can be made of forage by increasing PF(A)–S14 even further, and introducing calf rearing during the summer months, system PF(S)–S8. Straw, in an area typical of these corn and grass farms, would cost more than in an arable area. Even so, it was profitable to buy straw when necessary rather than to limit the number of beef cattle to the amount of straw grown on the farm. The plans suggest the purchase of over 40 tons of straw on C.3 and 56 on C.4.

With one minor exception, the systems selected did not use any succulent feed in winter, and therefore no decision of mangolds verses grass silage was necessary.

The farms for which plans have been calculated cover quite a wide range, and yet only 11 of the possible 32 systems have been selected. Indeed of these, two, PF(A)–S20 (No. 5) and S14(A)–S20 (No. 27), appear only because grass silage or chat potatoes were used instead of mangolds as a feed after Christmas. Without these advantages, the system S14(A)–S20 has a negative gross margin. Even where these feed stuffs are available the animals contribute so little to the total gross margin from beef that the system should be ignored in practice.

Table 11 shows the increase in gross margin that would be necessary before any of the other systems would appear in these plans. If the figure is small, then a small technical improvement would bring them in. But when the figure is large then even with better feeding methods or with a lucky purchase of stock, these other systems would not appear in the plans. It is only when the increase in gross margin needed falls to £10 or below that there is much chance for the system to prove profitable than the alternatives, however well managed.

Thus, although it is possible with skill to make a profit from buying forward stores for winter fattening, they are unlikely to give as good a return as, for example, barley beef. On the other hand, although

[1] In considering the results, it must be remembered that the data used was collected in East Anglia. While these are believed to be fairly representative, it might in some areas be necessary to make different assumptions.

it has not appeared in any of the suggested plans, PF(A)–F18 (No. 6), would, on certain types of farm, only need fairly small increases in gross margin to be profitably included.

For most of the suggested plans the change in gross margins per head to bring about an alteration in the plan is small. These plans are thus not stable over even quite small price changes. If, however, one of the systems in the plan were reduced in size because of relative price changes, it would be replaced by another system already in the plan, or one showing a low figure in Table 11.

Table 11 Increase in Gross Margin per Head needed before a given System of Beef Production will appear in the Present Optimum Plan

	System	*Farm A*				*Farm B*		*Farm C*			
		1 £	2 £	3 £	4 £	1 £	2 £	1 £	2 £	3 £	4 £
1.	PF–S3	(P)	1	(P)	1	(P)	(P)	(P)	1	(P)	1
2.	PF–F12	6	(P)	6	(P)	3	3	4	(p)	6	(p)
3.	PF(A)–S8	4	1	4	(P)	3	4	1	1	1	1
4.	PF(A)–S14	6	5	6	4	10	26	(P)	(P)	(p)	(P)
5.	PF(A)–S20	4	(p)	4	(p)	(p)	13	13	13	12	10
6.	PF(A)–F18	16	9	16	8	17	40	5	7	6	13
7.	PF–(A)–F24	(P)	(p)	(p)	(p)	8	59	1	(p)	2	(p)*
8.	PF(S)–S8	2	(P)	2	(P)	1	1	4	4	3	(P)
9.	PF(S)–S14	14	13	14	12	13	20	8	17	9	16
10.	PF(S)–S20	15	19	15	19	22	58	14	21	15	23
11.	PF(S)–F12	4	(P)	4	(P)	(p)	(p)	4	3	6	6
12.	PF(S)–F24	49	33	49	33	53	93	21	20	23	24
13.	SS–S8	21	12	21	12	30	94	18	3	14	4
14.	SS–S14	14	24	14	23	34	120	3	12	3	16
15.	SS–S20	20	35	20	36	47	161	14	22	15	28
16.	SS–F14	19	27	19	26	39	123	(p)*	9	(p)*	12
17.	SS–F24	49	48	49	48	72	190	23	26	25	34
18.	MS–S8	10	9	10	9	12	25	7	9	6	9
19.	MS–S14	19	15	19	14	22	46	11	12	11	13
20.	MS–S20	34	26	34	26	39	79	22	21	21	23
21.	MS–F24	35	32	35	32	47	113	14	20	14	26
22.	S8(A)–S14	21	12	21	12	19	26	10	9	11	12
23.	S8(A)–S20	24	22	24	21	30	66	16	15	17	21
24.	WSS(A)–F14	24	14	24	14	23	27	6	6	6	8
25.	S8(S)–S14	1	4	1	4	6	24	(P)	(P)	(P)	(P)
26.	S8(S)–S20	4	1	4	1	1	15	14	10	13	8
27.	S14(A)–S20	7	(P)	7	1	(p)	(p)	15	11	15	11
28.	S14(S)–S20	4	10	4	10	13	45	7	7	8	11
29.	S20(A)–F30	17	15	17	16	24	64	13	10	14	13
30.	S20(S)–F30	46	33	46	33	51	84	23	17	25	22
31.	S24(A)–F30	48	30	48	29	46	51	20	15	22	18
32.	S24(S)–F30	(p)	7	(P)	7	9	44	6	3	7	7

(P)=in plan as major enterprise (25 head or over). (p)=in plan as minor enterprise. *=too small to enumerate.

This chapter and those preceding it have dealt with the question of selecting a beef enterprise or enterprises to give the highest returns to available fixed resources. The rest of this report deals with the factors that affect the profitability of a given system.

References

(1) *The Pattern of Farming in the Eastern Counties* by B. G. Jackson, C. S. Barnard and F. G. Sturrock. Occasional Paper No. 8.

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PART II

FACTORS AFFECTING THE PROFITABILITY OF BEEF PRODUCTION

Chapter 6 Prices and Marketing

Part I was concerned with choosing between different systems of beef production. This section is concerned with improving the profitability of any given system. Up to this point, average levels of performance have been assumed, but with good management the farmer can obtain results well above average.

Profit can be described as gross margin less fixed costs. Fixed costs for items such as the use of land, buildings, etc. are not, however, likely to change appreciably with small modifications of any given system. It follows, therefore, that the profit depends mainly on the size of the gross margin. To increase profits the farmer must therefore increase the gross margin and it is on this point that attention will now be focussed.

How is this gross margin made up? On the credit side of the account there are cattle sales and other items such as the calf subsidy. The price at which an animal is sold depends on the method of sale (whether liveweight or deadweight), the season of the year at which it is sold, and on its breed weight and conformation.

Auction sales by liveweight still account for over 60 per cent of the animals certified under the Fatstock Guarantee Scheme. Many intensive 'barley beef' animals are sold deadweight, but from data collected in this survey this appeared to give no advantage. Most of the other cattle were sold live and in consequence no direct comparison was possible with the proceeds of deadweight sales.

When selling cattle, it often pays to 'shop around' to find the most suitable market. Even if it is not the nearest one, an extra 10p a hundred-weight would easily cover the extra transport if the market is within a reasonable distance. Any one animal can, of course, be sold in only one market and the farmer can never be certain that he might not have done better elsewhere. The farmer should certainly pay attention to the type of cattle sold at each market, because buyers congregate where they find the cattle they require. Some markets attract cattle of higher quality and it is a waste of time to send a poor-quality animal there. Not only would it be conspicuous among high-quality stock but buyers interested in buying that type of animal would not be present.

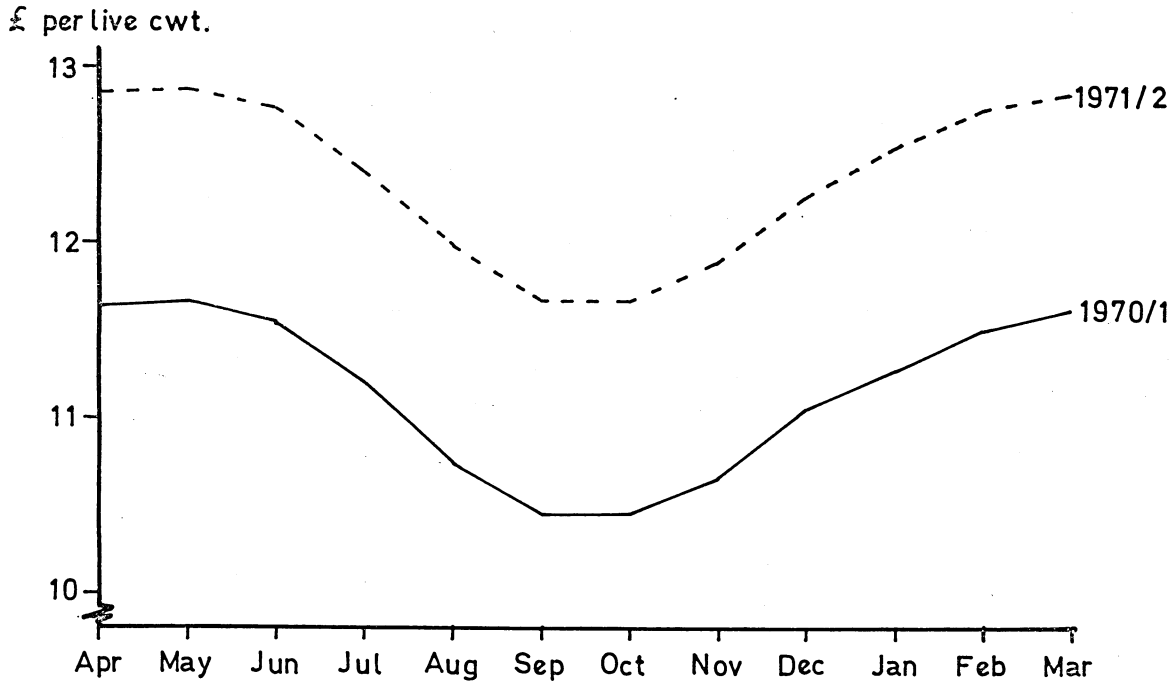
The time of year at which the cattle will be sold is largely settled as soon as the system is chosen. It is nevertheless possible to vary the date of sale by several weeks. In comparing prices at different dates allowance must of course be made for the cost of keep if sales are delayed.

For the older store cattle, the peak price is usually reached around the end of May, but this naturally depends on the weather. Graziers start to look for cattle only when the grass has made sufficient growth. In a cold, late spring when winter fodder runs out, markets are flooded with stores nobody wants and the price tumbles dramatically. A bonus awaits the farmer lucky enough to have fodder in hand at that time.

Many large spring store sales are fixed for early May and these attract large numbers of stock. In an early spring, however, prices may be highest in early April, just before the bulk of the stores reach the market. Prices usually reach their lowest ebb in October or November. Farmers selling stores in autumn should do so just before this period. Not only might this mean a slightly higher price but it would free labour in October, a busy time on most arable farms.

It is worth having a closer look at the seasonal pattern of prices. There is of course a guaranteed standard price and if auction prices are low, this is what the farmer receives. This standard price varies with the season with a peak in April and a trough in October as can be seen in Figure 2. If however prices are above the guaranteed level, then the market itself sets the seasonal pattern.

Figure 2 Monthly Standard Prices for Cattle 1970/1 and 1971/2



A producer holding cattle for a rise in price must of course allow for the extra cost of keeping them on the farm. If store cattle are being sold, the matter is simpler because prices are quoted per head. With fat cattle quoted at a price per cwt, allowance must be made for the loss in weight if sold early and the gain in weight if sold late. It is best therefore to turn the price into receipts per head. Thus if the current price is £9·50 and is expected to fall 10p a week, an animal weighing 9 cwt and gaining at 2 lb a day will be worth £85·50 now and £86·45 one month later. This small increase in value must then be set against the cost of keep, a point discussed in a later chapter.

In the press, the farmer is often told that 'the demand today is for a small joint'. This statement can be misleading. A butcher given the choice of two similar animals might prefer the smaller, but what interests the farmer is whether the butcher is prepared to back his choice of a small animal with a higher price per cwt. In fact when other factors have been taken into account, the differential for weight alone is small.

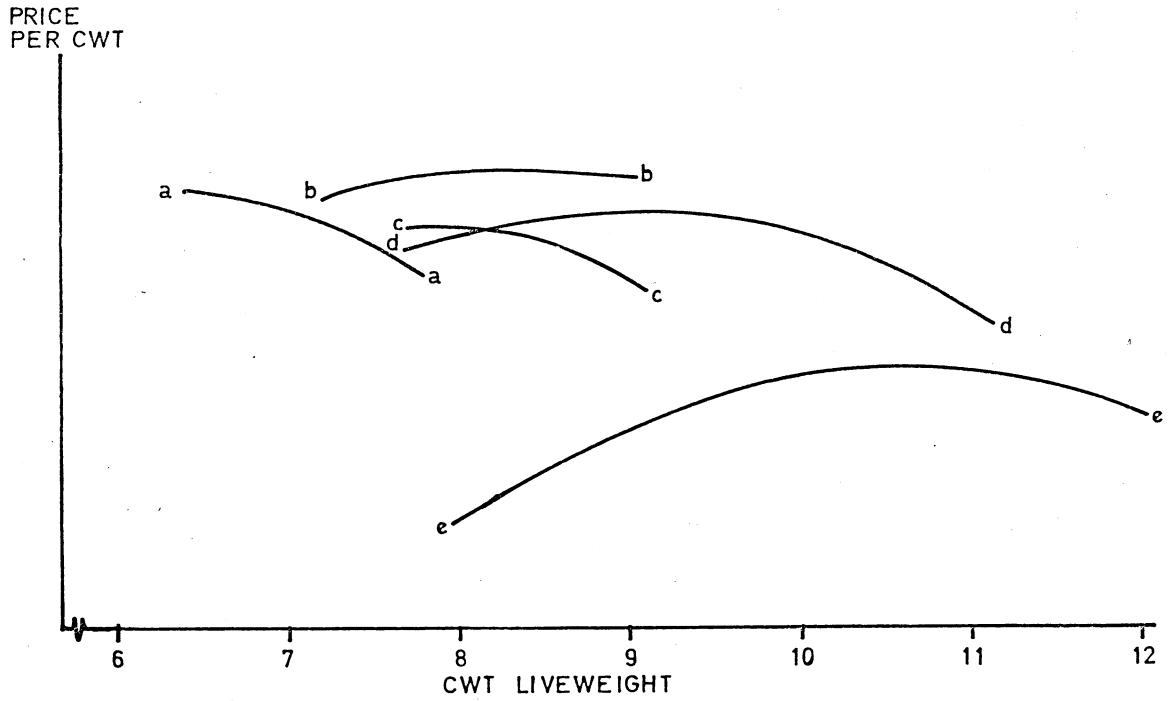
What is important is the degree of finish, and the weight at which an animal is ready for sale depends on sex, breed, and the system of feeding. A heifer of an early-maturing breed fed intensively may be so fat at 8 cwt that she suffers a marked fall in price per hundredweight. By contrast, a late-maturing steer fed on a low plane of nutrition may have so low a proportion of flesh to bone at lower weights that it may have to weigh 11 cwt before it reaches its top price per hundredweight. Providing an animal does not become overfat, then keeping it to gain an extra half hundredweight is unlikely to lower the price per hundredweight due to *weight alone*. Except at the lightest weights, steers nearly always realise a little more per hundredweight than heifers. Intensively-reared animals of a breed such as a cross-bred Friesian do not, however, show any difference in price between the sexes. Nor do single-suckled animals sold at 15 months.

Pure beef breeds, as might be expected, generally realise more per hundred weight than dual purpose or dairy cross-breds. But our most highly regarded pure beef breeds were bred specifically for early maturity on fairly extensive feeding. With this treatment heifers produce good carcases from 7 to 8½ cwt. and steers over a rather wider range, from 7½ to 10 cwt. With intensive feeding such animals start

to lay down fat at even lower weights. Above these weights, however, such animals tend to become too fat even with extensive feeding and the price per hundredweight falls rapidly.

If fed extensively Friesians are slow maturing and often fetch a lower price per hundredweight at 8 or 9 cwt than at 10 or even 11 cwt. But on intensive feeding, which seems to increase the physiological age, they produce good carcases at $7\frac{1}{2}$ cwt and upwards. This is the reason why this type of animal is more suitable for intensive fattening. Moreover, as they have less tendency to lay down fat than the pure beef cattle, the range of weight over which they are acceptable to the butcher is much wider. These price relationships are illustrated in Figure 3. Factors such as conformation have more influence on price per hundredweight in liveweight auctions than any of the other factors considered.

Figure 3 Price Curves according to Liveweight for Different Types of Cattle



a–a = pure beef, early maturing, heifer; intensive feeding
b–b = Friesian steer; intensive feeding
c–c = pure beef, early maturing, heifer; extensive feeding
d–d = pure beef, early maturing, steer; extensive feeding
e–e = Friesian steer; extensive feeding

Turning to the other side of the equation, what factors affect cost? Firstly, there is the cost of buying the animal. This item accounts for 96 per cent of variable costs for a forward store purchased to fatten off grass, down to 30 per cent for barley beef. It follows therefore that with larger animals kept less than six months, the purchase price is all important, because it accounts for such a large proportion of the total costs. Thus the profit from the traditional fattening of forward stores depends far more on the farmer's ability to buy cattle shrewdly than on his method of feeding them. Now, with the trend towards intensive and semi-intensive systems starting with young animals that spend most of their lives on one farm, the purchase price counts for less and food and labour count for more. There is far more scope for skilled management to increase profits. The most important aspect is feeding, because the other variable costs form such a small proportion of the total.

The remarks concerning the sale of stores apply equally to purchase. The price of grazing cattle is often lower just before the season opens. A grazier might thus find it worth while to have some fodder to enable him to buy cattle before the grass is ready. The extra food might cost as little as £2 for a month, whereas the difference in purchase price might be double this figure.

In autumn, it is generally better to buy in late October or early November, but the best time depends on the weather. If grass is short, graziers are forced to sell, but if it is plentiful they tend to hold bullocks until later in the season. Calf prices are generally low from the end of September until March. Although there is a rise in spring, the highest prices generally come in late May and June. This is because fewer dairy cows calve at that season. As this calving pattern shows no tendency to change, calf prices are likely to retain this seasonal pattern. Some rearers believe that calves born in January and February do not thrive as well as those born before Christmas. If this is the general opinion, demand may be reduced in these months. Seasonal increases in demand are therefore likely to occur in autumn and early winter especially if sale prices encourage increased marketing of intensive beef in the autumn.

Apart from choosing the time to buy, the individual producer has little control over the price he pays. Some farmers have a flair for buying cattle cheap, but to judge from this survey only one farmer buying forward stores for winter fattening was able in practice to buy cattle at a markedly reduced price. If the price is too high, the farmer can simply refrain from buying. He should calculate the probable gross margin and if it is too small, it is pointless to purchase stock. If enough fatteners adopted this attitude store cattle would be less often overpriced.

Apart from feeding stuffs, variable costs such as transport, veterinary fees, water, electricity should not exceed £2 per beast. It is thus apparent that feedingstuffs, which can account for 70 per cent of the cost in certain systems, are of prime importance. Indeed once the stock are purchased the cost of food is the one item that the farmer has under his control.

The remainder of this report deals with this vital factor in beef cattle management.

Chapter 7 Food Conversion Rates and their Significance

One criterion used in pig production as a guide to performance is the conversion ratio of meal into liveweight gain. It is only recently that serious attempts have been made to apply it to cattle production. A straightforward conversion ratio can be applied to barley beef cattle fed almost entirely on grain but it is not as satisfactory when bulky roughages and succulents are included in the diet. We thus need a method of converting such foods into a common denominator and the one used here is the starch equivalent published by the Ministry of Agriculture, Fisheries and Food in *Rations for Livestock*.

This method has been in use long enough to be understood by those responsible for formulating cattle rations and interpreting results at the farm level. No doubt a gradual change to the methods advocated in the Agricultural Research Council's publication, *The Nutrient Requirements of Farm Livestock, No.* 2 *Ruminants*, will take place, but as yet insufficient details for various diets are available for everyday use. Furthermore, it was of greater value in this study to give feeds an absolute value (whether calories or some other unit of measurement such as Starch Equivalent is used for this purpose makes little difference) and to see from results on that basis the effect of different diets.

Because the age and previous treatment of cattle purchased was not always known, no account could be taken of these factors in this investigation. Purchased cattle were therefore classified simply by weight. As the intervals between weighings were not constant, the weight groups were based on the calculated weight mid-way between weighings rather than the initial weight.

The levels of feeding were analysed into three groups: a concentrated diet with 80 per cent or more of the starch equivalent coming from concentrates, a medium diet with 50–80 per cent starch equivalent from cencentrates, and a bulkier diet with less than 50 per cent from concentrates. The sample was then divided into high plane of nutrition (sufficient to allow animals to fatten at twelve months on a high-concentrate diet) and medium plane of nutrition (enough to gain at least 1½ to 2 pounds liveweight per day). It was intended to have a third group on a low plane of nutrition, but very few animals were fed at that level. The results are given in Tables 12, 13 and 14.

The high-concentrate feeding table (12) includes intensive barley beef and other pail-fed calves started on a concentrated diet, up to the point where they changed to a less-intensive one. One point of interest is the steady rise in conversion ratio from below 3:1 to over 6:1 as the animals approach 900 lbs liveweight[1].

Although food consumption per 1 lb gain increases steadily as the animal grows, this is compensated by the lower cost of the ration and on balance the cost per 1 lb continues to fall. For this reason, the lowest *cost* per pound liveweight gain is attained when the animals are about 250–350 lbs. Normally the ration is not changed again after the cattle reach 400 lbs. This means that the conversion rate continues to increase, the cost per pound liveweight gain rises steadily[2].

The liveweight gains per day unexpectedly reached a maximum when the animals weighed 500 lbs, although the batch with the highest daily gains of 3·7 lbs occurred in Group 6, for animals of 574 lbs. That this is not just an effect of averaging can be seen from the ranges. The first batches of cattle costed did not show this falling off of liveweight gain per day, although the maximum reached was 2·9 lb per day. From the Ministry of Agriculture, Fisheries and Food publication *Aids to Management—Beef*, it is apparent that the data obtained from the Rowett Institute showed increasing daily liveweight gain right up to 900 lbs liveweight. However, it is known that animals fed to realise their maximum growth rate exhibit an S-shaped growth curve. That is, daily growth rate is low in very young animals, increases to a maximum at puberty, and thereafter decreases.

[1] The number of heavy-weight batches was reduced because some animals were ready for sale between weighings, and it was found impossible to allow for the food consumed.

[2] The slight fall in costs in Group 9 is due to one farm with an unusually cheap ration in a group of only three farms.

Table 12 85% or over of Total Starch Equivalent from Concentrates
(Fed to finish at 12 months)

Size Groups	*Average Liveweight (lbs)*	*Liveweight gain per beast per day (lbs)*	*Cost per beast per day (new pence)*	*Cost per lb. liveweight gain (new pence)*	*S.E. per beast per day (lb)*	*S.E. Conversion Ratio*	*No. of batches*	*Total No. of animals weighed*
Group 1								
Average	137	0·78	5·4	6·9	2·2	2·8	3	72
Range	125–145	0·73–0·81	4·8–6·0	5·9–7·5	2·0–2·5	2·4–3·3		
Group 2								
Average	214	1·62	8·2	5·2	4·4	2·7	8	161
Range	168–244	1·16–2·21	4·0–10·9	3·3–6·9	2·2–5·8	1·8–3·5		
Group 3								
Average	299	2·2	11·0	4·9	6·7	3·0	10	145
Range	250–333	1·7–2·6	7·3–13·9	3·6–6·8	5·0–9·6	2·5–3·7		
Group 4								
Average	402	2·7	14·6	5·4	9·4	3·5	15	240
Range	359–448	1·8–3·4	10·6–19·1	3·7–7·9	7·3–17·7	2·6–5·7		
Group 5								
Average	516	2·8	17·6	6·5	10·6	3·9	12	199
Range	479–545	2·1–3·2	14·2–19·5	4·7–7·6	9·3–14·3	3·1–4·4		
Group 6								
Average	604	2·6	18·2	7·0	11·2	4·3	15	225
Range	558–647	2·1–3·7	16·0–22·8	4·3–8·9	10·0–13·2	2·7–5·9		
Group 7								
Average	708	2·6	20·2	8·0	12·4	4·9	20	437
Range	670–749	1·8–3·1	15·6–29·7	6·0–10·9	10·2–14·8	3·9–6·2		
Group 8								
Average	783	2·5	21·4	8·6	13·2	5·3	9	104
Range	752–813	1·7–2·9	16·3–24·1	6·2–12·5	12·1–14·3	4·3–6·3		
Group 9								
Average	832	2·3	20·1	8·4	14·2	6·3	3	51
Range	363–903	1·7–2·8	9·2–26·7	5·2–11·2	12·7–15·0	5·4–7·2		

Table 13 50%–80% of Total Equivalent from Concentrates
(Fed to give theoretical gain at least 1½ lb–2 lb Liveweight per day)

Size Groups	*Average Liveweight (lbs)*	*Liveweight gain per beast per day (lb)*	*Cost per beast per day (new pence)*	*Cost per lb liveweight gain (new pence)*	*S.E. per beast per day (lb)*	*S.E. Conversion Ratio*	*No. of batches*	*Total No. of animals weighed*
Group 3								
Average	331	2·1	8·9	4·3	5·5	2·7	3	42
Range	308–349	1·9–2·2	7·7–9·9	3·6–4·9	4·9–6·2	2·2–3·3		
Group 4								
Average	402	2·2	12·9	5·9	8·9	4·1	2	35
Range	380–425	2·0–2·4	9·2–16·5	3·9–8·0	6·2–11·7	5·7–2·6		
Group 5								
Average	514	1·67	8·9	5·4	7·4	4·5	5	47
Range	489–532	1·3–1·9	7·0–10·2	5·0–6·1	6·6–8·3	4·0–5·5		
Group 6								
Average	612	1·66	10·4	7·0	9·2	6·3	16	285
Range	572–649	0·5–2·9	7·5–14·6	3·0–15·3	7·5–12·1	2·8–14·9		
Group 7								
Average	698	1·59	11·1	7·7	10·0	7·0	15	369
Range	661–746	1·0–2·6	8·0–15·2	4·5–11·8	8·1–13·4	3·6–11·6		
Group 8								
Average	796	1·83	13·6	7·8	11·3	6·6	18	365
Range	752–846	0·9–3·4	9·5–24·1	5·1–16·1	9·1–14·3	4·1–12·3		
Group 9								
Average	904	2·0	15·2	8·0	12·3	6·7	12	155
Range	863–949	1·0–2·9	11·2–24·4	5·9–13·1	9·7–15·0	4·9–10·7		
Group 10								
Average	1028	2·0	14·2	7·6	12·2	6·7	13	143
Range	963–1159	1·0–4·0	11·5–17·7)	3·8–13·9	10·3–14·0	2·6–10·7		

Table 14 Under 50% of Total Starch Equivalent from Concentrate
(Fed to give theoretical gain at least 1½ lb liveweight per day)

Size Groups	*Average Liveweight (lbs)*	*Liveweight gain per beast per day (lb)*	*Cost per beast per day (new pence)*	*Cost per lb liveweight gain (new pence)*	*S.E. per beast per day (lb)*	*S.E. Conversion Ratio*	*No. of batches*	*Total No. of animals weighed*
Group 5								
Average	526	1·47	5·9	4·2	7·0	5·0	3	34
Range	525–528	1·0–1·9	4·4–8·8	3·2–4·6	6·2–9·3	4·1–6·9		
Group 6								
Average	611	1·4	8·2	6·7	10·8	8·7	5	184
Range	575–645	0·7–2·0	6·2–10·1	4·3–11·5	9·2–12·5	5·9–14·5		
Group 7								
Average	703	1·7	8·9	5·7	11·3	7·4	13	333
Range	656–746	0·8–2·6	7·4–12·1	3·6–13·9	8·4–16·4	5·4–19·5		
Group 8								
Average	837	1·97	9·3	4·9	13·6	7·3	5	70
Range	802–849	1·3–2·6	7·9–11·3	3·5–7·0	11·0–15·3	6·0–10·2		
Group 9								
Average	914	1·3	6·6	7·2	14·2	15·6	3	31
Range	889–938	0·5–1·9	5·1–7·6	2·7–13·8	10·6–15·5	5·6–30·2		
Group 10								
Average	1034	1·5	10·6	9·0	13·4	11·4	13	139
Range	951–1150	0·3–2·4	8·6–14·3	4·3–33·3	11·2–21·2	5·0–41·0		

Samuel Brody in *Bioenergetics and Growth* states that the maximum daily liveweight gain for cattle is reached at about 30 per cent of mature weight. Applying this to the point of maximum growth from this sample would give a mature weight of nearly 15 cwt. As most animals on this type of feeding were Friesian or Friesian-cross steers, this seems quite plausible. It seems reasonable to predict therefore that cattle fed *ad lib* on a high concentrate diet, to achieve maximum growth will reach their highest daily liveweight increase at a third of their mature weight. Heifers will therefore reach this point at lighter weights than steers, and steers presumably before bulls. Light weight breeds will reach it before heavy weight.

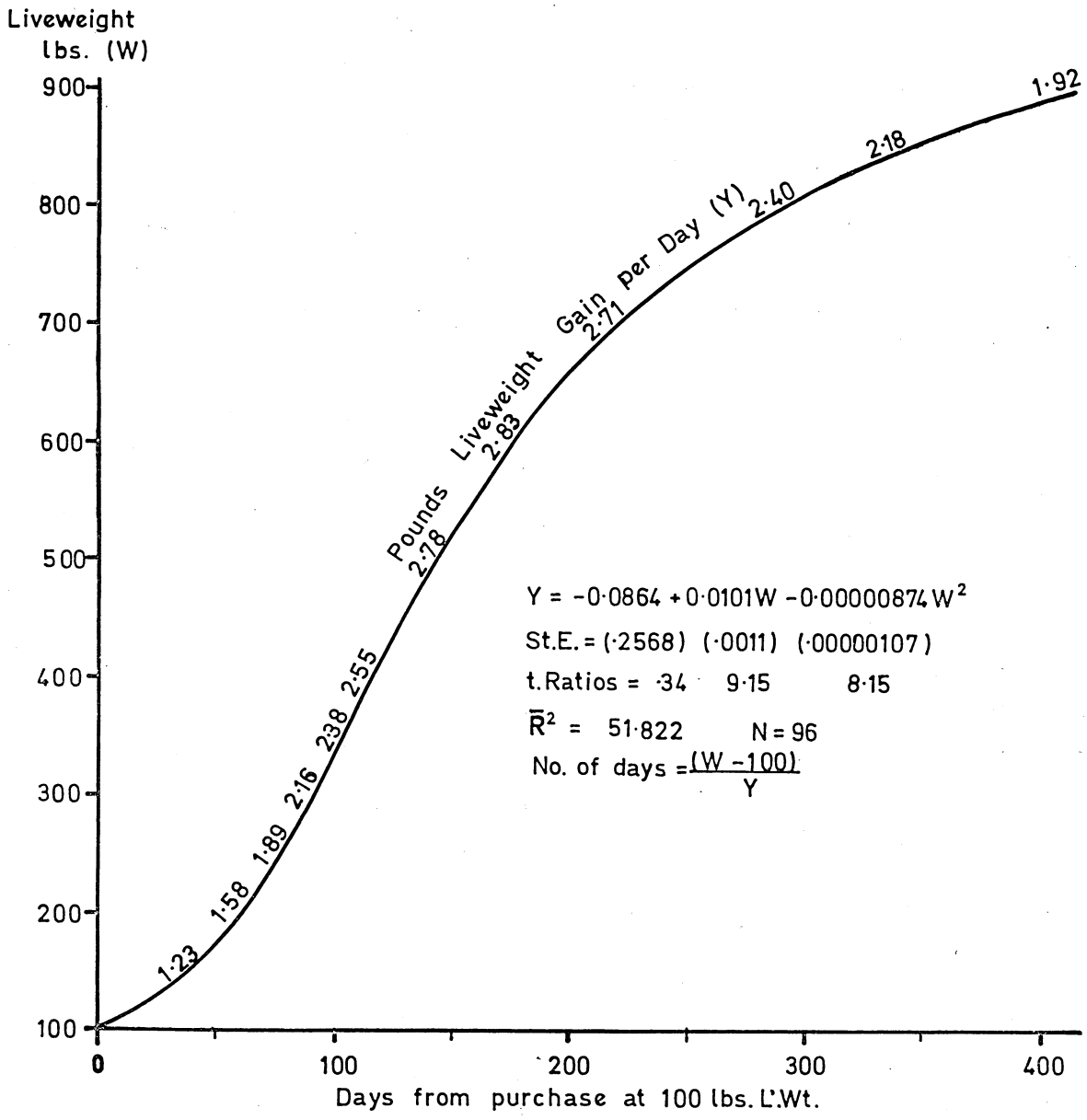
The point of maximum liveweight gain is not, however, the one where gains are obtained most economically, because conversion ratios increase steadily throughout the life of the animal. Figure 4 has been prepared from regressions on the data presented in the tables. In addition to daily liveweight gains, it shows the total weight which will be reached a given number of days from purchasing a calf weighing 100 lbs.

The next type of feeding, i.e. 50–80 per cent of S.E. provided by concentrates, covers systems such as the traditional fattening of forward stores (52 per cent of starch equivalent from concentrates on average feeding), the fattening of weaned single-suckled calves by 15 months of age (60 per cent) and the second winter for the semi-intensive system PF(A)–F18 (51 per cent). It therefore covers the more normal final period of producing beef animals.

One striking difference between these and the intensively-fed cattle is the lack of change in weight gain over the whole range, and cost per pound liveweight gain and conversion ratio for animals of heavier weights. Analysed statistically, no significant correlation was found between the weight of animal and daily liveweight gain. This is partly because the animals were rationed to gain about 2 lb per day. This is not however the only reason, because cattle with a higher level of feeding did not necessarily show greater weight gains. It is possible that the cattle chosen for this system of feeding had a lower growth potential than those on higher-concentrate diets[1].

[1] See also the comments on page 40 concerning liveweight gains on high bulk diets.

Figure 4 Liveweight Gain Pattern for Intensively-fed Cattle "Barley Beef"



*These regressions are the best obtained from the data and demonstrate that although there is some correlation, it does not account for sufficient of variation to allow deeper analysis of the beef feeding problems.

On statistical analysis it was found that no significant change in food conversion rates occurred from 700 lbs upwards for these animals. The cost per pound liveweight gain moreover did not change from 700 lbs. to the maximum recorded weight of 1,100 lbs. As no records were available beyond this point, it is not known how conversion rates would behave. Presumably if the animals were kept until they started laying down much fat, the conversion ratio would rapidly get worse.

Again it appears that margins over feed costs were small on average from 700 lbs liveweight upwards. This is borne out by the difficulty of obtaining worthwhile gross margins from winter feeding of forward stores. Hence the need to buy stores for indoor fattening at a lower price per hundredweight than they realise when fat. By contrast, a farmer rearing young stores to 5 cwt can afford to pay as much or more per hundredweight for the calf he purchases as he expects to get when the animal is sold.

The final table of weighing and food recording results deals with high-bulk diets, where less than 50 per cent of total starch equivalent comes from concentrates. Typically this system of feeding is intended for store cattle. From the costings survey normal feeds for stores from 8–20 months contained an average of 36 per cent of starch equivalent from concentrates. That the rations on the weighing survey were intended for fattening seems probable in that the amount fed in most cases, as in the table, were theoretically sufficient to give a daily liveweight gain of at least 1½ to 2 lb. As in the previous group (50–80 per cent S.E. from concentrates) there was no significant correlation between the liveweight gain of the animal and its weight. But it is interesting that the average liveweight gain is even lower than in the previous table, although the disappearance[1] of feed was even higher, except for Group 5.

There is also the question of the starch equivalent content of the feedingstuffs used in this survey. In most cases, these were estimated because direct calorimetric testing was not practical. While such an estimate would not be satisfactory in a feeding experiment, it is adequate for the purpose intended. The purpose of this study is to find what happens under farm conditions, using the kind of information available to farmers and their advisors. Because the estimated starch equivalent may differ from the real value, some slight errors in conversion rates could be expected in individual cases. But such errors if present would tend to cancel out in a reasonable sample and would not account for the differences between feeding systems, unless the samples used for preparing the tables in *Rations for Livestock* had consistently better samples of bulky feed for analysis than on the farms in the present study. This seems hardly likely. It seems that this study bears out the findings in the A.R.C. publication *The Nutrient Requirements of Farm Livestock, No.* 2 *Ruminants* that the efficiency with which the metabolizable energy of diets is used increases as the concentration of the diet increases.

Thus although economical liveweight gains can be obtained in some cases from feeding high-bulk rations, in other cases with low liveweight gains, the cost can be astronomically high.

The next step is to discover the underlying causes for the results obtained. The factors in which we are interested are costs per pound livestock gain, and the food conversion rate.

The reduction of *cost* per pound liveweight gain is the ultimate aim. This, however, depends on the costs per unit of feedingstuffs, which can change. In this study, purchased concentrates were charged at cost, and forage crops (which are part of the cattle enterprise) at variable cost of production. This method enables the gross margin of cattle per acre of forage and grass devoted to them to be calculated. The acreage of cereals is not included because the grain crop is counted as a cash crop selling grain to the cattle at market price.

To compare farms following the same system, the cost per pound gain is a useful measure. But when different systems are being compared care must be taken in interpreting the results. For this purpose the food conversion rate is generally a more useful method of comparison. Conversion rates for any given type of feeding change only the improvement in the capabilities of the stock used. As this is a slow process, conversion rates can be used over quite a long period.

Multiple regressions were carried out on data collected in the feed recording survey to see which factors had a significant effect on (a) cost per pound liveweight gain; (b) starch equivalent conversion ratio. The factors tested included initial weight, growth rate, S.E. consumed per day, proportion of S.E. from concentrates. In addition, sex, time of year the cattle were weighed and size of batch were taken into consideration. The results are given in Appendix C. The factors found to be important in deter-

[1] The word 'disappearance' is used deliberately. From the economic viewpoint, we are not simply interested in the feed actually consumed by the animals but by the total used, including barley filched by sparrows and hay trodden underfoot. With some bulky feeds, particularly when fed *ad lib*, there is liable to be considerable waste and this is included in the calculations.

mining the cost per pound liveweight gain were the rate of growth, consumption of S.E. per day, and proportion of S.E. from concentrates.

Other things being equal an increase in growth rate of 1 lb per day would reduce the cost per pound liveweight gain by nearly 4p. An increase of 10 per cent in the proportion of starch equivalent from concentrates would raise costs by just over $1\frac{1}{2}$ per cent per pound liveweight gain. An increase of 1 lb S.E. per day in the ration would increase the cost by $\frac{1}{2}$p. The actual levels are less important than the relative values. These indicate that to minimise cost per pound liveweight gain the farmer must have animals with good growth ability. He should feed them at or slightly below recommended levels and he should substitute bulk for concentrates wherever possible. This latter recommendation needs some qualification, because it depends on the opportunity cost of producing forage on the farm concerned. It is also true that if too much bulk is included the conversion rate will deteriorate and the cost per pound liveweight gain will increase. This will not usually occur if the diet still remains within one of the three main divisions given.

Turning to food conversation ratios, the factors affecting them were statistically analysed using multiple regression analysis. The factors examined are listed in Appendix C. It was hoped that sufficiently close relationships could be established between such things as quality of concentrated food and the weight of animals so that more detailed recommendations could be made about matching quality of rations to age and size of cattle but the fact that there were no statistically significant relationships which explained more than some 50 per cent of the variations found in the survey must rule out such further analysis. It is not very surprising that close relationships could not be established since it is well-known that the variations between cattle performance within one farm may be very wide, and in a survey of this type the variations between farms are likely to add to this problem. The complete analysis however was not statistically significant and therefore as much as we would like, it is impossible to justify further analysis.

Appendix A

NET PRESENT VALUE OF ALTERNATIVE SYSTEMS AT VARIOUS DISCOUNT RATES

No.	System	(A) Buildings available on farm								(B) Including new buildings							
		Not Discounted		Discounted at 5%		Discounted at 10%		Discounted at 15%		Not Discounted		Discounted at 5%		Discounted at 10%		Discounted at 15%	
		5 years	10 years	5 years	10 years	5 years	10 years	5 years	10 years	5 years	10 years	5 years	10 years	5 years	10 years	5 years	10 years
1.	PF–S3	9,844	20,179	8,905	16,268	8,128	13,479	7,477	11,438	4,369	10,864	3,779	8,406	3,290	6,653	2,881	5,371
2.	PF–F12 (continuous)	4,833	11,693	3,763	8,201	2,895	5,795	2,183	4,088	2,117	7,032	1,351	4,532	730	2,809	221	1,587
3.	PF(A)–S8	6,589	13,809	5,933	11,076	5,390	9,129	4,935	7,703	3,177	8,242	2,717	6,325	2,336	4,959	2,017	3,958
4.	PF(A)–S14	8,231	17,246	7,412	13,834	6,734	11,402	6,166	9,622	4,885	11,595	4,276	9,055	3,770	7,245	3,350	5,920
5.	PF(A)–S20	2,989	7,054	2,179	4,633	1,526	2,988	994	1,838	298	3,078	—260	1,411	—711	280	—1,078	—509
6.	PF(A)–F18	4,962	11,507	3,956	8,205	3,139	5,927	2,469	4,310	2,146	6,816	1,425	4,454	840	2,825	360	1,668
7.	PF(A)–F24	6,501	15,151	5,323	11,091	4,363	8,269	3,572	6,251	3,685	10,185	2,798	7,130	2,075	5,008	1,479	3,490
8.	PF(S)–S8	5,994	12,619	5,392	10,112	4,894	8,324	4,476	7,016	2,757	7,402	2,335	5,644	1,985	4,391	1,693	3,473
9.	PF(S)–S14	5,352	11,752	4,770	9,330	4,289	7,603	3,886	6,339	1,699	6,099	1,259	4,434	895	3,247	591	2,378
10.	PF(S)–S20	4,582	9,512	3,674	6,725	2,941	4,823	2,342	3,487	1,839	5,814	1,104	3,561	511	2,024	26	945
11.	PF(S)–F12 (one batch)	4,135	9,290	3,667	7,339	3,279	5,948	2,954	4,930	2,010	5,980	1,649	4,478	1,351	3,407	1,101	2,623
12.	PF(S)–F24	3,913	9,523	3,063	6,718	2,374	4,782	1,807	3,406	1,550	5,675	923	3,607	413	2,180	—5	1,167
13.	SS–S8 (cows in)	4,561	10,466	3,540	7,261	2,715	5,066	2,039	3,518	3,012	7,982	2,151	5,280	1,454	3,430	884	2,125
	(cows out)	4,561	10,466	3,540	7,261	2,715	5,066	2,039	3,518	4,561	10,466	3,540	7,261	2,715	5,066	2,039	3,518
14.	SS–S14 (cows in)	4,966	11,246	3,961	7,998	3,146	5,764	2,478	4,181	2,339	6,964	1,596	4,567	994	2,917	500	1,750
	(cows out)	4,966	11,246	3,961	7,998	3,146	5,764	2,478	4,181	3,484	8,844	2,625	6,069	1,928	4,160	1,357	2,808
15.	SS–S20 (cows in)	4,909	10,254	3,764	6,909	2,842	4,647	2,091	3,071	2,813	6,873	1,938	4,323	1,235	2,598	662	1,398
	(cows out)	4,909	10,254	3,764	6,909	2,842	4,647	2,091	3,071	3,717	8,327	2,727	5,436	1,929	3,482	1,280	2,120
16.	SS–F14 (cows in)	5,281	11,876	4,248	8,509	3,409	6,190	2,721	4,545	2,302	6,967	1,568	4,580	973	2,935	484	1,769
	(cows out)	5,281	11,876	4,248	8,509	3,409	6,190	2,721	4,545	3,933	9,758	3,019	6,782	2,278	4,733	1,670	3,279
17.	SS–F24 (cows in)	2,624	8,269	1,813	5,536	1,154	3,642	612	2,293	309	4,259	—261	2,341	—724	1,013	—1,105	67
	(cows out)	2,624	8,269	1,813	5,536	1,154	3,642	612	2,293	1,061	5,496	422	3,345	—97	1,855	—524	793
18.	MS–S8	4,585	10,125	3,851	7,566	3,253	5,785	2,759	4,509	2,360	6,455	1,811	4,550	1,363	3,224	994	2,276
19.	MS–S14	5,589	13,054	4,455	9,316	3,535	6,736	2,779	4,902	2,115	7,040	1,382	4,603	786	2,919	296	1,721
20.	MS–S20	3,661	9,086	2,635	5,963	1,806	3,837	1,130	2,345	1,252	5,282	486	2,955	—132	1,370	—637	259
21.	MS–F24	5,735	12,935	4,574	9,193	3,632	6,620	2,860	4,798	2,495	7,135	1,735	4,701	1,120	3,028	615	1,845
22.	S8(A)–S14	1,056	3,101	870	2,327	716	1,775	587	1,371	—718	692	—846	158	—952	—221	—1,040	—500
23.	S8(A)–S20	2,463	6,118	2,131	4,734	1,856	3,748	1,626	3,027	403	2,998	167	2,016	—27	1,315	—191	803
24.	WSS(A)–F14	1,181	3,351	984	2,530	821	1,944	684	1,516	—19	1,701	—175	1,050	—305	586	—413	246
25.	S8(S)–S14	4,386	8,936	3,972	7,214	3,630	5,986	3,344	5,088	4,386	8,936	3,972	7,214	3,630	5,986	3,344	5,088
26.	S8(S)–S20	1,502	4,152	1,261	3,149	1,062	2,434	895	1,910	180	1,770	—357	1,032	—503	506	—626	120
27.	S14(A)–S20	all negative at present prices								all negative at present prices							
28.	S14(S)–S20	1,858	3,938	1,669	3,151	1,512	2,589	1,381	2,179	1,858	3,938	1,669	3,150	1,512	2,589	1,381	2,179
29.	S20(A)–F30	1,672	4,512	1,414	3,437	1,200	2,671	1,022	2,110	592	2,932	380	2,046	204	1,415	56	953
30.	S20(S)–F30	374	1,884	237	1,312	123	905	28	607	—630	580	—740	122	—830	—204	—907	—443
31.	S24(A)–F30	all negative at present prices								all negative at present prices							
32.	S24(S)–F30	1,840	3,880	1,655	3,108	1,501	2,558	1,373	2,155	1,840	3,880	1,655	3,108	1,501	2,558	1,373	2,155

cows out: Single-suckling cows out-wintered where reasonable shelter is available and severe poaching will not occur.

Appendix B

INPUTS OF LABOUR, LAND AND ACCOMMODATION PER HEAD SOLD PER ANNUM

No.	System	LABOUR (Hours)[1]										FORAGE ACRES			ACCOMMODATION	GROSS MARGIN PER HEAD £
		Early Spring		Late Spring and Early Summer		Late Summer and Early Autumn	Late Autumn		Winter	Carting and Spreading FYM	Total hours	Grazing and/or Hay	Succulent Fodder	Total acres	(sq. yards)	
		Direct	Forage	Direct	Forage	Direct[2]	Direct	Forage	Direct							
1.	PF–S3	1·0	0	1·5	0	1·0	1·0	0	1·5	0·3	6·3	0	0	0	0·3	3·0
2.	PF–F12 (continuous)	2·8	0·2	4·2	1·4	2·8	2·8	0	4·4	3·0	21·6	0·20	0	0·2	5·5	16·9
3.	PF(A)–S8	3·4	0	0	1·0	2·0	3·5	0	5·1	1·0	16·0	0·10	0	0·1	2·8	12·3
4.	PF(A)–S14	3·4	0·6	2·1	1·5	3·4	4·0	1·0	5·0	1·0	22·0	0·50	0	0·5	2·8	19·2
5.	PF(A)–S20	8·0	0·9	2·1	3·4	3·4	6·3	1·5	12·0	4·0	41·6	0·60	0·20	0·8	8·3	18·4
6.	PF(A)–F18	8·0	3·3	1·8	5·7	1·8	8·2	3·3	12·3	4·0	48·4	0·86	0·14	1·0	9·4	31·2
7.	PF(A)–F24	8·0	1·8	3·3	7·5	4·2	6·3	4·6	15·5	2·7	53·9	1·60	0·20	1·8	8·3	43·0
8.	PF(S)–S8	3·8	0	5·1	1·0	3·4	1·7	0	0	1·0	16·0	0·10	0	0·1	2·8	11·3
9.	PF(S)–S14	9·0	1·2	5·1	5·5	3·4	4·3	3·5	7·9	3·0	42·9	0·30	0·10	0·4	5·5	16·0
10.	PF(S)–S20	9·0	2·2	6·2	5·5	4·0	4·6	3·5	7·9	3·0	45·9	1·10	0·10	1·2	5·5	21·2
11.	PF(S)–F12 (one batch)	6·0	0·2	4·0	1·4	2·0	2·0	0	3·0	3·0	21·6	0·20	0	0·2	5·5	16·9
12.	PF(S)–F24	11·2	2·3	6·2	13·2	4·0	11·2	9·0	20·8	5·0	82·9	1·36	0·24	1·6	13·9	33·0
13.	SS–S8	3·8	3·2	3·0	8·2	2·0	3·7	7·5	9·0	0 or 3·0	40·4 or 43·4[3]	2·04	0·26	2·3	0 or 11·0[3]	31·1
14.	SS–S14	7·7	3·8	3·0	12·7	2·0	7·6	10·5	16·8	2·3 or 5·3	66·4 or 69·4	2·34	0·36	2·7	5·5 or 16·5	36·8
15.	SS–S20	7·9	4·8	3·9	13·3	2·6	7·7	10·5	16·8	2·3 or 5·3	69·8 or 72·8	3·14	0·36	3·5	5·5 or 16·5	36·7
16.	SS–F14	7·8	3·2	3·0	14·9	2·0	7·7	12·2	15·5	2·3 or 5·3	68·6 or 71·6	2·24	0·36	2·6	5·5 or 16·5	38·6
17.	SS–F24	12·3	4·9	3·9	21·5	2·6	12·1	16·2	28·8	4·8 or 7·8	107·1 or 110·1	3·40	0·50	3·9	13·9 or 24·9	48·4
18.	MS–S8	5·6	0·5	4·5	3·1	3·2	5·6	1·0	11·0	1·5	36·0	0·44	0·06	0·5	3·9	14·2
19.	MS–S14	7·7	0·7	5·4	5·9	3·8	7·7	2·5	14·8	2·5	51·0	0·80	0·10	0·9	6·6	21·2
20.	MS–S20	9·5	1·6	6·0	9·2	4·2	9·5	5·5	18·3	4·0	67·8	1·30	0·20	1·5	10·0	23·3
21.	MS–F24	12·5	2·9	6·6	12·1	4·6	12·7	8·7	24·9	6·5	91·5	1·92	0·28	2·2	10·5	40·0
22.	S8(A)–S14	3·9	0·6	0	4·5	0	3·9	3·0	7·8	2·0	25·7	0·30	0·10	0·4	5·5	5·5
23.	S8(A)–S20	4·2	2·2	0·9	4·5	0·6	4·1	3·5	7·8	2·0	29·8	0·10	0·10	1·2	5·5	10·6
24.	WSS(A)–F14	4·0	0·5	0	5·5	0	4·0	5·0	7·5	2·3	28·8	0·18	0·12	0·3	5·5	7·5
25.	S8(S)–S14	0·3	0·6	1·9	0·5	1·3	0·3	1·0	0	0	5·9	0·50	0	0·5	0	8·6
26.	S8(S)–S20	3·8	0·9	1·9	2·4	1·3	3·8	1·5	7·0	3·0	25·6	0·60	0·20	0·8	6·6	7·8
27.	S14(A)–S20	3·5	0·3	0	1·9	0	3·5	0·5	7·0	3·0	19·7	0·22	0·18	0·4	6·6	—0·8
28.	S14(S)–S20	0·3	1·6	0·9	0	0·6	0·2	0·5	0	0	4·1	0·90	0	0·9	0	5·1
29.	S20(A)–F30	3·7	1·2	1·0	6·2	0·7	3·7	4·6	9·0	2·2	32·3	1·22	0·18	1·4	5·5	12·5
30.	S20(S)–F30	2·4	1·6	1·1	7·6	0·8	6·6	6·0	13·0	2·8	41·9	1·06	0·14	1·2	8·3	7·6
31.	S24(A)–F30	2·2	0·6	0	7·0	0	6·6	6·0	13·0	2·8	38·2	0·26	0·14	0·4	8·3	—0·3
32.	S42(S)–F30	0·2	1·0	1·2	1·0	0·6	0	0	0	0	4·0	1·00	0	1·0	0	7·2

(1) Number of animals per batch normally 20–40; direct hours per head for much larger or smaller batches would differ from those shown. Fodder acreages and forage hours are based on silage before the New Year, and mangolds after.

(2) No forage hours because it is assumed that straw would be baled whether cattle on farm or not. Other forage does not generally require work during this period.

(3) Single-suckling cows are the only cattle normally out-wintered. Where these are yarded in winter, the higher figures apply.

Appendix C

Multiple Production Function Variables

Dependant Variable

Y = Cost per pound of liveweight-gain.

Independant Variables

X^1 = The farm on which the cattle were recorded.

X^2 = The batch of cattle.

X^3 = The number of animals in the batch.

X^4 = The breed of cattle (1. Friesians; 2. Friesian Cross; 3. Hereford or Hereford Cross (other than Friesian); 4. Shorthorn or Lincoln Red; 5. Aberdeen Angus or Aberdeen Angus Cross).

X^5 = % males in the batch.

X^6 = Time of year.

X^7 = Total weight of beast (calculated weight mid-way between weighings).

X^8 = Weight gain per beast per day.

X^9 = Starch Equivalent per beast per day in pounds.

X^{10} = % Starch Equivalent from concentrates (100%=1).