Sugar beets

Agricultural Enterprise Studies
in England and Wales
Economic Report No. 7

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SUGAR BEET:

A Study of Sugar Production in the UK and the feasibility of expansion

F. G. Sturrock & M. C. Thompson

Agricultural Economics Unit
Department of Land Economy
University of Cambridge

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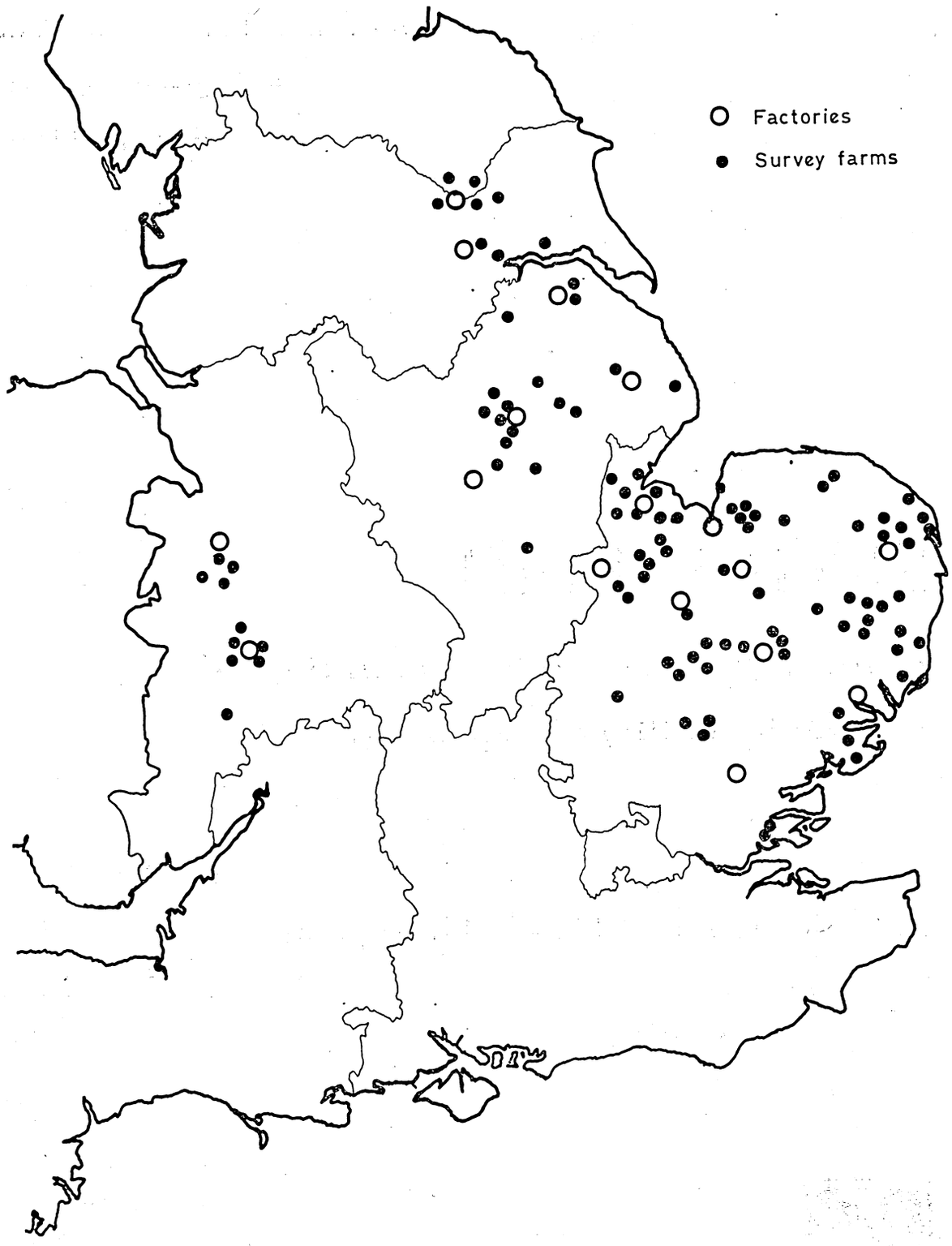

Frontispiece. Location of farms taking part in the Survey and the sugar beet factories.

Sugar beet is grown mainly in Eastern, E. and W. Midland and Yorks and Lancs (MAFF) regions. The S.W. and S.E. were considered for a new factory.

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Foreword

The economics of particular crop or livestock enterprises have been investigated and reported on by individual departments of agricultural economics at universities in England and Wales for several decades. In this work the departments have received—and continue to receive—generous support, financial and technical, from the Ministry of Agriculture, Fisheries and Food.

From time to time, the departments meet—together with representatives of the Ministry—to discuss common problems in their enterprise study work. One recent development has been the mounting of joint studies by two or more departments with a special interest in a particular enterprise. As a natural sequence, it has been decided that, although the reports will continue to be prepared and issued by individual departments, this community of interest should be recognised by giving the reports a common series title. Hence emerged the series the 'Agricultural Enterprise Studies in England and Wales'. Any views expressed or conclusions drawn are those of the authors.

Recent titles and the addresses of university departments concerned are given at the back of the report.

Preface

This report is based on a national survey of sugar beet organised in Cambridge. The opportunity has been taken, however, to discuss possible future developments. It is now three years since the present writer made a comparison with West Indies production and first suggested an expansion of sugar beet in this country by 100,000 acres. This report deals with the feasibility of such a project in more detail. As entry to the E.E.C. seems imminent, the subject is obviously of topical interest.

The authors are indebted to the farmers who so willingly provided information on their methods of growing sugar beet. They are also indebted to their colleagues in the Universities of Bristol, Nottingham and Manchester who interviewed farmers in their areas. Their thanks are also due to Mr. W. C. Housden who prepared much of the statistical material and Mrs. Ann Bain who typed and corrected the manuscript.

Cambridge
July, 1972

F. G. STURROCK
Director, Agricultural Economics Unit

Introduction

For many years our policy with regard to sugar supplies has remained unaltered. A very reasonable working arrangement had been reached—we produced a third of our supplies from home grown sugar beet and we imported the remainder, nearly all of it cane sugar from the Commonwealth. The prospect of joining the Common Market however has thrown this convenient division of the market into the melting pot and before the Commonwealth Sugar Agreement expires in 1974, a new policy must be evolved. This therefore is the time at which to look afresh at the arrangements for our supplies.

Before doing so, it is worth reviewing briefly the circumstances that dictated policy in the past. In the seventeenth and eighteenth centuries, most of our supplies came from West Indian islands in British possession and were produced on estates worked with slave labour. For many years sugar cane was a prosperous industry but when in 1834 slavery was abolished in British possessions, the plantations were hard hit and production declined in importance until it revived once again in this century.

In the meantime, the sugar beet industry had come into being. The extraction of sugar was first accomplished by Marggraf, a German chemist, in 1747 but production on a commercial scale in Europe did not take place until it was encouraged by Napoleon during the blockade of the French coast by the British navy. Once started, however, the sugar beet industry was fostered and grew in importance. Indeed, by 1913, 80 per cent of our supplies were beet sugar imported from Europe.

During the First World War, supplies from that source were interrupted and the trade in cane sugar was revived. In the 1920's Empire trade was fostered and again we came to depend on imported raw cane sugar refined in this country.

During the Second World War, supplies were secured by the Ministry of Food, largely from the Commonwealth and this arrangement was formalised in 1951 by the Commonwealth Sugar Agreement. Under this arrangement, we guaranteed a market for a quota of sugar at an agreed price based on a '. . . reasonably remunerative price to efficient producers'.

In the meantime, a sugar beet industry had been created in this country in 1924. At that time, British agriculture was depressed and arable farming in particular was vulnerable to cheap imports. In the traditional Norfolk four course rotation, (clover, wheat, fodder roots, barley) soil fertility was maintained by clover that fixed nitrogen and fodder roots that allowed the farmers to clean the land of weeds. So long as either cereals or fat livestock were profitable, this system (and other variants based on it) held together but in the 1920's and 1930's the prices of grain and meat were both low and arable farmers had to face the competition of cheap imports from countries that did not require as expensive a system of maintaining fertility.

There were two weaknesses in the traditional arable rotations. The first was that the proportion of cash crops was low. The second was that the growing of fodder roots whether for folding sheep in the field or for carting to cattle in yards was labour intensive and the output was insufficient to pay the wages of the labour force required.

One solution proposed by the Ministry of Agriculture was the introduction of sugar beet. Not only did this provide an additional high value cash crop to replace the fodder roots but the tops and the sugar beet pulp provided fodder for livestock. Sugar beet was also a cleaning crop.

To establish the crop, a subsidy was promised for ten years, while farmers became accustomed to growing the crop. At the end of this time, however, the industry was still not viable and the subsidy was continued. The eighteen factories which had until then been managed by private enterprise were however taken over by the British Sugar Corporation, a public corporation in which the Government has an interest.

Although from the point of view of husbandry sugar beet seemed an ideal remedy for the hard pressed arable farmer, the introduction of this crop was severely criticised at the time. There were two main reasons. The first was that by growing sugar we were depriving the West Indies of a market

for their produce and that if we improved the lot of the British arable farmer, it was at the expense of West Indies sugar workers who were also suffering from the effects of the world wide depression.

The second criticism was that a subsidy on sugar beet was an expensive way of giving aid and helped farmers in only one part of the country—the East of England. It was further suggested that a labour intensive crop such as sugar beet was never likely to compete with sugar cane grown in tropical countries with much lower wage rates. Indeed, for many years it was taken for granted by writers on agricultural policy that sugar beet survived as a crop only because it was protected from competition from imports. Production in this country was also limited to preserve a market for Commonwealth countries, most of them undeveloped and heavily dependent on the British market for traditional exports such as sugar.

As will be shown in this report, the position has changed. The efficiency of production of sugar beet has improved substantially. The yield per acre has doubled and labour requirements have fallen by more than 80 per cent. Sugar beet is thus competitive at least with West Indian cane sugar. It is therefore no longer necessary to defend the sugar beet crop solely as a special form of protection for British farmers.

In joining the Common Market, moreover, a new aspect is introduced. We shall no longer be able to choose supplies from the cheapest sources but will be compelled to pay for refined sugar at E.E.C. prices which are higher than those now paid to our farmers or to the Commonwealth. In these circumstances, it would be to our advantage to grow more sugar in this country. The aim of this report is to examine this proposition from such evidence as is available.

CHAPTER 1

A Survey of British Sugar Beet Production

The Sample

The survey of sugar beet grown in 1970 was based on a random sample of 104 farmers. The sample which was drawn by the British Sugar Corporation was stratified into three size groups according to the acreage of beet grown on each farm under 20 acres, 20 to 50 acres, and over 50 acres. As the number of farms in each stratum was approximately proportional to the acreage of sugar beet in that stratum, each acre of sugar beet in England and Wales had an equal chance of inclusion in the sample.

	Acres	*Holdings*		*Sugar Beet*	
Stratum	*Sugar Beet*	*Number*	*Per cent*	*Acres*	*Per cent*
1	1–19¾	14,826	69·6	105,554	25·0
2	20–49¾	4,428	20·8	132,114	31·2
3	Over 50	2,046	9·6	185,241	43·8
		21,300	100·0	422,909	100·0

Representative farms were drawn from all the factories. The distribution was as follows:—

Eastern Counties	71
East Midlands	16
West Midlands	10
Yorkshire	8
	105

No attempt was made to sample Scottish growers (which are outside the jurisdiction of this department). Since then, the Cupar factory has been closed.

Statistical Criteria

The analysis of the survey results was carried out using the normal distribution and the associated probability functions. Figure 1.1 shows the distribution of gross margin per acre over the whole sample and clearly demonstrates the normality of the sample.

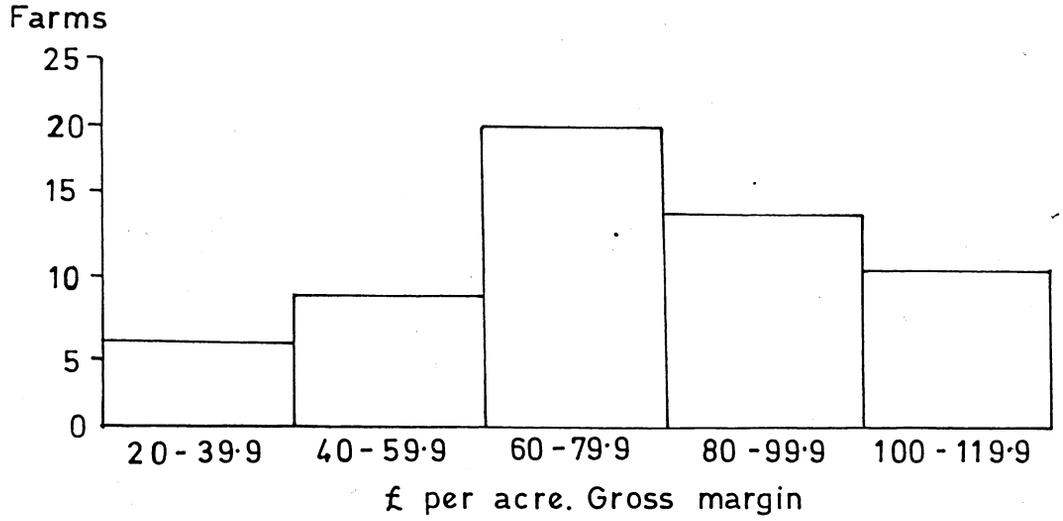
Some of the survey results are concerned with examining and describing sub samples classified within the total sample by a variety of classifications. All comparisons between sub samples are examined using Analysis of Variance to test for significant classifications. Where more than two 'classes' are analysed at the same time t tests are used to examine the significance of the difference between class means. The residual variance obtained in the analysis of variance was used as a best estimate of the population variance.

Bartlett's test for homogeneity of variance was used with every analysis of variance and in no analysis was there need to reject the results because of heterogeneity of variance.

The calculated F and t ratios are only quoted in the results where conclusions are based on marginally significant results but the level of significance is indicated by asterisks placed near the results, thus:—

* = P 0·05 ** = P 0·01 *** = P 0·001

Figure 1 Distribution of Gross Margin per acre



Costs of Production

Details of the assumptions made are given in the Appendix. The costs and returns of the three size groups are shown in Table 1.1. Three results are shown:—

1 Gross Margin A. This is output less variable costs for seed, fertiliser and sprays. As the same items of cost are deducted on each farm the Gross Margin A provides a useful method of comparing individual farms and groups. In this case, the figures are £93·0, £93·2 and £80·7 on the small, middle and large groups. As the costs of seed, fertiliser and sprays are fairly similar in all three size groups, the lower G.M. of the large group is mainly due to the lower yield and output (£100·5 per acre compared to £115·2 and £114·2).

2 Gross Margin B. This is output less *all* variable costs including contract work and casual labour. This is the G.M. that reflects most accurately the marginal contribution of the crop on each farm towards covering fixed and overhead costs and providing a profit. It is thus the figure used to plan an individual farm. It is less useful however as a means of comparing groups because the list of cost items deducted is not the same on all farms. The 'other' variable costs on the small group at £22·0 are substantially higher than the medium or large groups (£14·5 and £10·7 respectively). This is because farmers in the small group rely more heavily on contractors for haulage and cultivations. In the larger groups where the farmers make more use of their own lorries and implements, the costs of this equipment appear lower down in fixed costs.

3 Net Margin. To arrive at this figure deductions are made from the output not only for variable costs but also for an estimated share of fixed costs and overheads.

In total, fixed costs are apparently similar in all three groups. There are, however, some differences in detail. The smaller units have lower costs for machinery because as already noted, they rely on contractors to a greater extent.

As can be seen in Tables 1.2 and 1.3, the large units use significantly less labour for ploughing, seedbed preparation, hoeing and spraying. As these are mostly on large farms with large fields and implements, this is to be expected. On the other hand, more labour is used for haulage and other operations left to contractors on the small units.

4 Total Costs. In total, costs decline significantly from £93·8 on large units to £78·8 on small units. Receipts are £115·2 and £114·2 on small and medium units and £100·5 on the larger units. The latter figure reflects the lower yields on the large units (13·5 tons per acre compared to 15·6 and 15·1 tons per acre). The net margins are £21·4, £31·5 and £21·4 per acre respectively.

These are the averages but it should be stated that there are wide variations in individual results. Although the average net margin is £25 per acre, 15 of the 104 growers concerned showed a loss whereas 17 had net margins exceeding £50 or more than twice the average. An examination of the individual results showed that the size of unit had no relationship whatever either to gross or net margin. In other words, there is no indication that the small grower is at any disadvantage in margin over costs in comparison with the large unit.

5 Gross Margin and Net Margin. As can be seen from Figure 1.2, the size of the net margin is related very closely to the yield of beet per acre. The equation is as follows:—

$$Y = -162{\cdot}77 + 5{\cdot}69x_1 + 6{\cdot}19x_2$$
$$\quad\quad (55{\cdot}54)\quad (0{\cdot}41)\quad\quad (3{\cdot}29)$$
$$\overline{R}^2 = 66{\cdot}87$$

Y = Net margin, x_1 = yield (tons/acre), x_2 = % sugar.

Figure 1.2 Effect of yield per acre on net margin over all costs

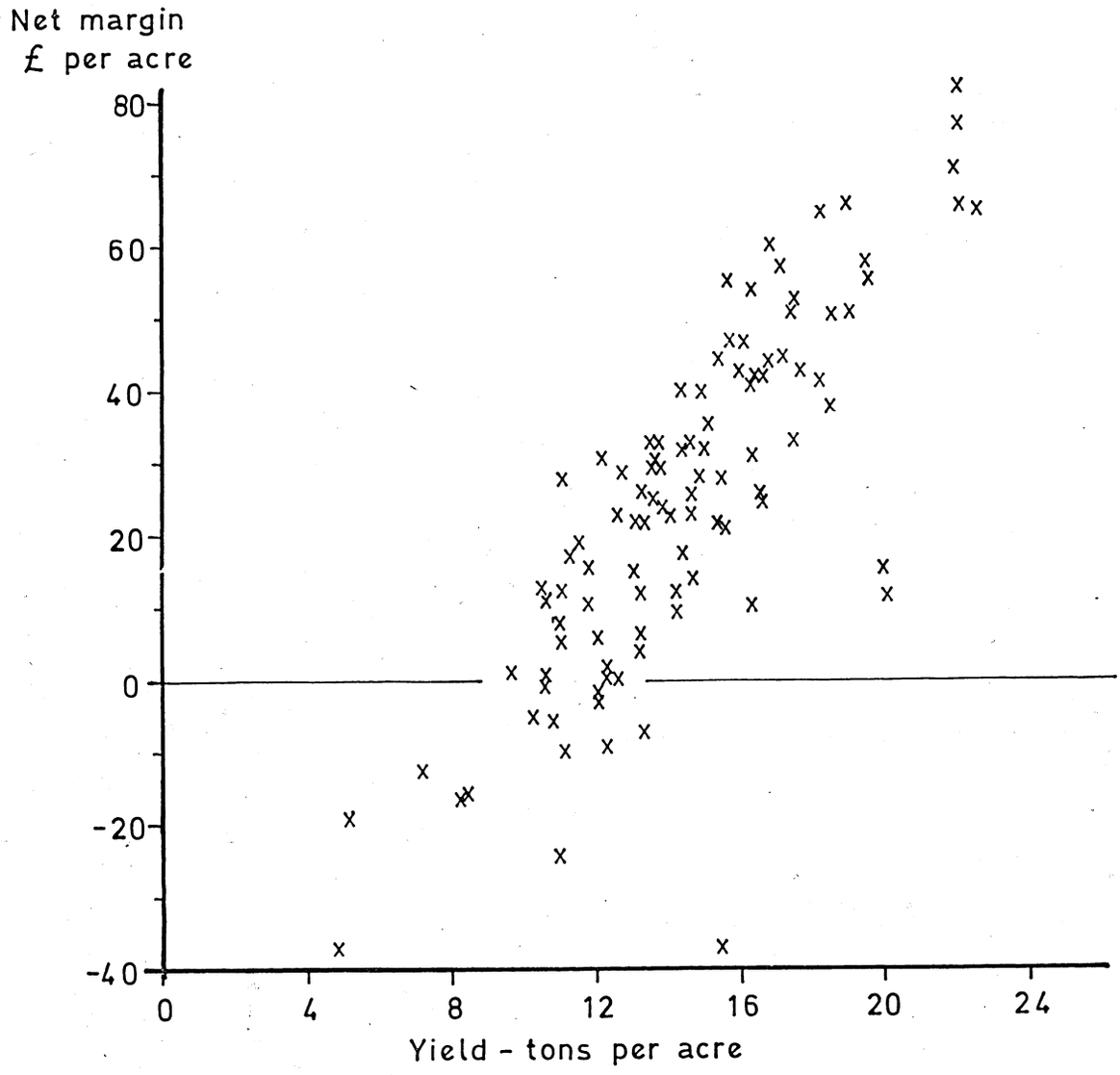


Table 1.1 Costs per Acre (Weighted by Grower)

	Small		*Medium*		*Large*	
Acres of sugar beet:	1–20		20–50		50 and over	
Number of farms	20		32		52	
Yield per acre (tons)	15·6		15·1		13·5	
Sugar content	17·2%		17·1%		17·1%	
Gross output		£115·2		£114·2		*£100·5
Variable Costs:						
Seed	4·6		4·0		3·6	
Fertiliser	13·6		13·0		12·1	
Sprays	4·2[1]		4·0		4·1	
		£22·2		£21·0		£19·8
Gross Margin A[1]		£93·0		£93·2		*£80·7
Contract haulage	12·2		8·4		5·3	
Contract other	6·5		2·1		0·7	
Casual labour	3·3		2·6		2·4	
Regular labour bonus	—		0·9		1·6	
Miscellaneous	—		0·5		0·7	
		£22·0		£14·5		£10·7
Gross Margin B[1]		£71·0		£78·7		£70·0
Fixed Costs:						
Regular labour	14·9		12·7		14·7	
Haulage (own lorries)	—		1·4		1·6	
S.B. machinery	1·7		***4·7		3·8	
Share of other implements	***2·0		1·3		1·2	
Tractors	7·8		6·9		7·0	
Machinery (total)	11·5		14·3		13·6	
FYM line B/slag, etc.	0·6		0·5		0·6	
Rent and rates	10·2		8·9		9·1	
Other overheads	***12·5		10·8		10·3	
Total fixed costs		£49·6		£47·2		£48·5
Summary:						
Gross Output (receipts)[1]		£115·2		£114·2		£100·5
Total Costs[1]		**£93·8		***£82·8		£78·8
NET MARGIN[1]		£21·4		£31·5		£21·4

Gross Margin A. This is a useful standard when comparing different farms or groups.
Gross Margin B. This is the figure that would be used in planning or programming individual farms.

[1] Rounding errors occur in different calculations involved and produce errors in sub totals.

Table 1.2 Labour Requirements

Man hours/acre		*Small*	*Medium*	*Large*	*Average*	*S.E.*
Stubble work		1·3	0·8	1·0	1·0	0·14
FYM application		0·5	0·5	0·5	0·5	0·12
Ploughing	***	2·5	1·6	1·5	1·7	0·09
Seedbed preparation	***	2·9	1·4	1·2	1·6	0·13
Fertiliser application	***	1·3	0·6	0·6	0·7	0·07
Drilling and weed spraying	**	0·3	0·8	0·8	0·7	0·05
Spraying		0·5	0·5	0·4	0·4	0·04
Handhoeing		15·9	9·6	13·0	12·8	1·14
Tractor hoeing	***	9·8	3·9	2·9	4·5	0·61
Harvesting and loading		9·6	9·7	10·3	10·0	0·65
Haulage		0·5	2·1	3·5	2·5	0·47
Total		45·1	31·5	35·7	36·5	1·80
S.E.		6·9	1·8	1·9		

Table 1.3 Tractor Requirements

Tractor hours/acre		*Small*	*Medium*	*Large*	*Average*	*S.E.*
Stubble work		1·3	0·8	1·0	1·0	0·14
FYM application		0·5	0·4	0·5	0·5	0·10
Ploughing	***	2·5	1·7	1·5	1·7	0·09
Seedbed preparation	***	2·9	1·4	1·2	1·6	0·13
Fertiliser application	***	1·3	0·6	0·6	0·7	0·07
Drilling and weed spraying	**	0·3	0·8	0·8	0·7	0·05
Spraying		0·5	0·4	0·4	0·4	0·04
Tractor hoeing	***	5·7	3·4	2·9	3·6	0·32
Harvesting and loading		8·7	9·7	10·6	10·0	0·64
Total		23·6	19·2	19·4	20·2	0·90

Of the variance in net margin, yield alone accounts for 66·03 per cent. As will be noted, the break even point (at 16 per cent sugar) is 11 tons per acre. In other words, crops below 11 tons show a negative net margin. Total costs including a share of overheads and other fixed costs, have been used hitherto in the Price Review to calculate changes from year to year.

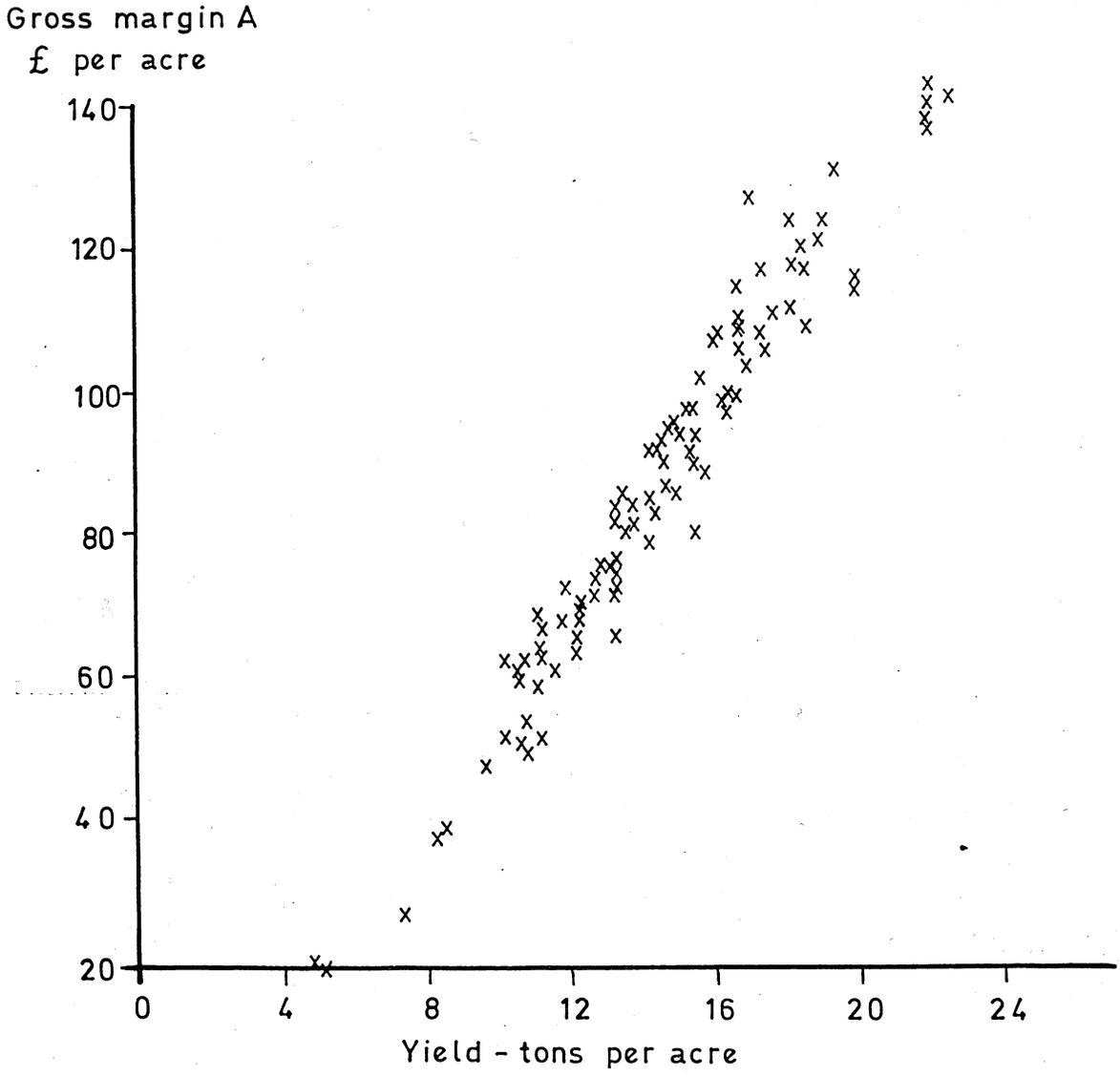
Total costs and net margin are not of much interest to the farm adviser. If the net margin is £25, an extra acre will not necessarily increase the profit of the farm as a whole by £25. Nor will a loss of one acre necessarily reduce it by £25. This is because nearly 60 per cent of the costs are fixed and do not change in proportion to the area of sugar beet grown.

If a farmer growing 50 acres of sugar beet were able to grow an extra 10 acres, the additional profit would be the Gross Margin B less any extra fixed costs incurred for labour, machinery and overheads. If the G.M. were £70 an acre and if the existing labour and sugar beet harvester could deal with the extra 10 acres, the extra profit would be £70 per acre less the G.M. of the crop displaced. If this were barley (G.M. £30) the net increase in profit would be £40 per acre or £400 for 10 acres.

This would be a useful addition to income. On the other hand, if the men and equipment were so fully employed that an extra 10 acres compelled the farmer to buy a new harvester or employ an extra man, the extra fixed costs for these items could easily swamp the additional £400 gross margin expected and make the change unprofitable. In practice, 19 farmers out of 20 growing sugar beet would fall into the former category and gain all or nearly all the extra gorss margin as an additional profit, but each case would have to be considered on its merits. It will be noted, however, that the decision on whether to grow more sugar beet depends not on the net return but on the gross margin less any additional fixed costs.

Having noted the importance of the Gross Margin to the adviser, it is of interest to note the factors affecting its size. Figure 1.3 shows the effect of yield and sugar content on the Gross Margin A.

Figure 1.3 Effect of yield per acre on gross margin A (receipts less cost of seed, fertilisers and sprays)

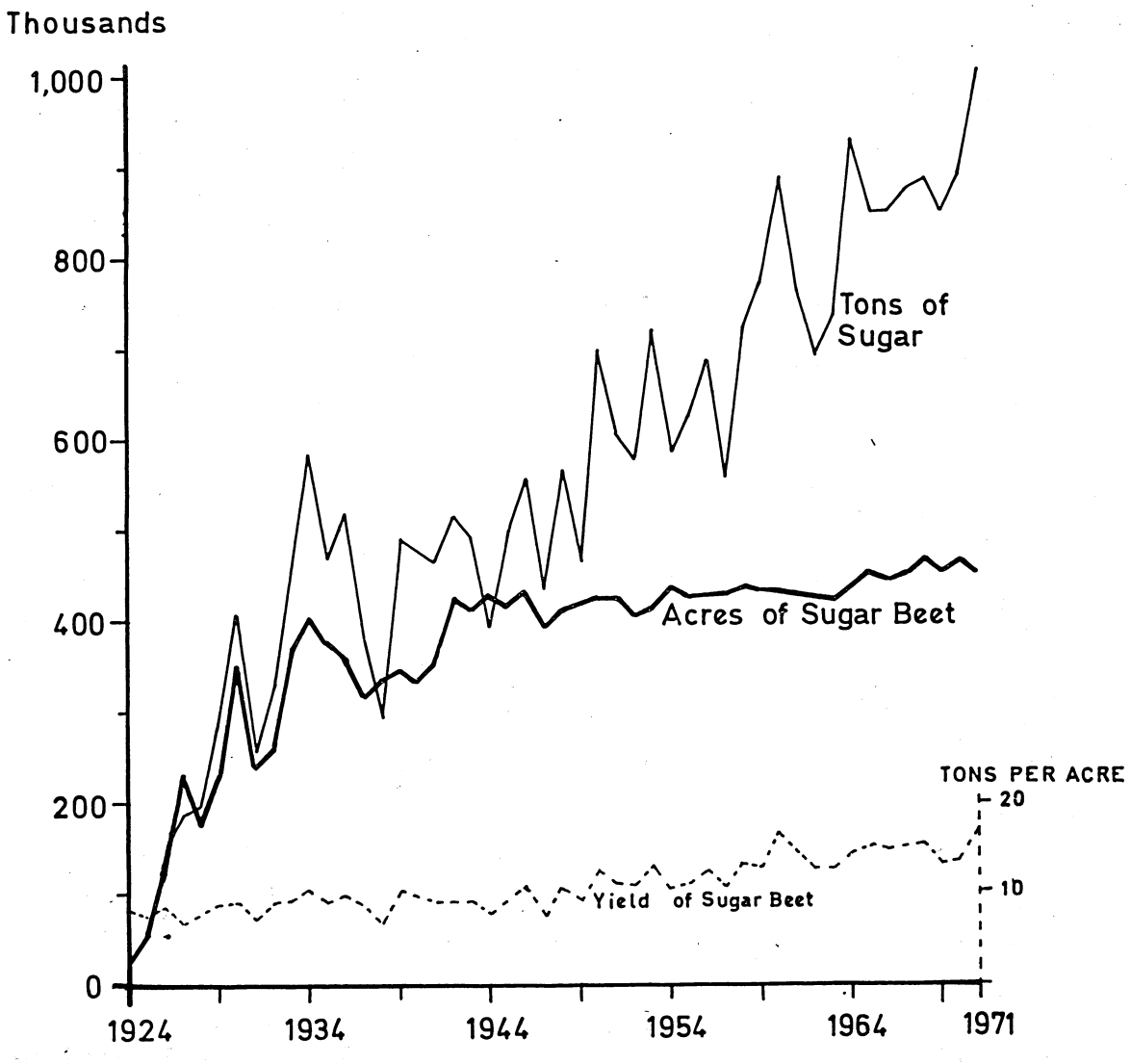


$$Y = -124{\cdot}99 + 7{\cdot}26x_1 + 6{\cdot}28x_2$$
$$(19{\cdot}65) \quad (0{\cdot}15) \quad (1{\cdot}17)$$
$$\bar{R}^2 = 96{\cdot}31.$$

Yield per acre alone accounts for 95·28 per cent of the variance and yield with sugar content for 96·31 per cent. It is thus obvious that the gross margin A depends almost entirely on yield per acre.

The effect of increased yields on output can be seen from Figure 1.4. It will be seen that although the acreage has increased very little since 1942, the output of sugar has doubled. In broad terms, production of sugar was approximately one ton per acre in the 1920's. By the 1950's, yield was $1\frac{1}{2}$ tons per acre. It has now reached 2 tons per acre.

Figure 1.4 Production of home grown sugar and acreage of sugar beet (U.K. 1924–1971)



Fertilisers

No relationship whatever was evident between yield of beet and expenditure on fertilisers. This apparently anomalous result has been noted in other surveys. The most likely explanation is as follows. If we were dealing with a field of uniform soil laid out in experimental plots, we would expect that larger applications of fertiliser would (within reasonable limits) produce larger yields. But in a survey of this kind, many types of soil at many levels of fertility are included. On the whole, farmers are

knowledgeable about the use of fertiliser. In consequence, we find that farmer A intending to grow sugar beet on a thin sandy soil in poor condition applies a heavy dressing and obtains only a modest yield. Farmer B on rich fen soil applies a light dressing because this is all it requires and nevertheless obtains a higher yield than farmer A. Without allowing for differences in soil and fertility, these two results by themselves might appear to indicate a negative return to fertiliser. It is thus obvious that it is to the experimental plot and not the general survey that we must look for an accurate estimate of the affect of increasing dressings of fertiliser.

Low Labour Crops

As harvesting is now largely mechanised, the remaining labour peak is thinning and hand hoeing the crop in late spring.

One objective of the survey was to analyse the difference between crops grown in the traditional way, with polygerm seed and large labour inputs, and those grown using monogerm seed, drilled to a stand and with minimal hand labour. A 'very low labour group' of 27 farmers using less than 10 man hours for hand hoeing was therefore separated from the whole sample to analyse the differences. It was hoped that there would be a number using no hand hoeing. There were farmers who used no hand hoeing on part of their crop but only three (all small farms) had grown the whole of their crop using none. Many growers however merely 'walked over' their crops to tidy up localised weed problems or because there was little other work available for the staff. These growers were included in the 'very low labour group'.

Table 1.4 Very Low Labour Group
(S.E. figures in brackets)

£ *per acre*		*Very Low Labour Group 27 Farms*		*Remaining Farms 77 Farms*
Yield (tons)		13·4		14·0
		£		£
Gross output		103·7 (4·7)*		108·7 (3·0)*
Variable Costs				
Seed	4·1		4·1	
Fertilisers	13·6		13·3	
Sprays	4·5		3·9	
Materials Variable Costs		22·2		21·3
Margin over materials		81·5 (4·6)*		87·4 (3·0)*
		£		£
Range of margins per acre		19·5 to 131		20·4 to 141
Man hours per acre (excluding haulage)		22·0 (0·08)		38·0 (2·1)
Tractor hours per acre		18·9 (1·1)		20·4 (1·1)
Specialised machinery capital per acre		13·5 (2·2)		11·4 (14·6)

* Note: Differences not significant at 0·05 level ($F_c = 0·73$).

The results for the high and low labour groups are shown in Table 1.4 where a 'Gross Margin over materials only' (A) has been used to highlight the differences between groups.

It will be seen from Table 1.4 that the seemingly large difference between the average Gross Outputs is not statistically significant. This is because of the variation found within the two samples. The variation is reflected to some extent in the 'range of margins' shown in Table 1.4. The variation doubtless arises from many factors including soils, climates, and management.

Experimental work on yields of sugar beet and such factors as variety, type, seed spacing, hand work and machinery work has been carried out for some time, particularly by the National Institute of Agricultural Botany (N.I.A.B.)[1] and the British Sugar Corporation (B.S.C.).[2] The findings of this work have shown quite clearly that (a) monogerm varieties have a 5 per cent lower *yield potential* than polygerm varieties.

(b) That hand singled crops, singled from close seed spacing, usually produces higher plant populations and thus higher yields irrespective of varieties.

The results of this survey, shown in Table 1.4, show that in farm practice the variations are greater than in field trials and that experimental findings are camouflaged by other factors.

One important fact emerges. In 1970 the difficult spring followed by summer droughts produced very testing conditions for crops drilled to wide spacings to reduce hand work. It is clear from this study that the low labour group did not suffer more than the higher labour group.

Thus the low labour techniques passed a severe test in 1970 and growers can be encouraged by this if the system appeals to them in spite of the acknowledged lower yield *potential.*

The saving of hand hoeing will only improve income, of course, if bills can be decreased or saved regular labour can be diverted to more profitable work elsewhere on the farm. It will be noted on Table 1.4 that seed and herbicide costs are not very dissimilar in the two groups. One would expect to find higher seed and herbicide costs associated with low labour systems but it is clear from analysis of the survey that many growers had trouble with unreliability or unpredictability of herbicides. Many growers for instance had to use overall sprays of Herbon Gold after band spraying had produced unsatisfactory results. It is well known that herbicides are still not completely reliable but this situation is improving and, except in unusual years like 1970, one can expect to see a cost differential appear. The effects of the price differential between seed varieties is disguised by the mixed varieties and techniques used on the same farm.

The relationship between man hours per acre for hand hoeing and thinning and yield per acre is shown in Figure 1.5. It is evident that farmers using only a minimum of labour do not seem to have suffered lower yields.

Transport

Two-thirds of the farmers used contractors to take their beet to the factory. Costs varied but the average fitted the following equation:—

$$\text{Cost (p) per ton} = \underset{(3\cdot79)}{52\cdot08} + \underset{(0\cdot19)}{1\cdot27}x \qquad \bar{R}^2 = 43\cdot0$$

When x = miles to factory.

On this basis a 15 ton crop would cost:—

	Per Ton £	*Per Acre* £
10 miles	0·65	9·75
20 miles	0·77	11·55
30 miles	0·90	13·51

[1] N.I.A.B. Variety recommendations for Sugar Beet Annual recommendations.
[2] Sugar Beet Research and Education Committee Annual Reports 1968–1970.

About a third of the farmers used their own lorries. The following is a comparison of the costs per acre:—

Contract Haulage		*Own Lorry*	
Average cost	£11·5	Fuel	£1·4
		Share of lorry upkeep	£3·6
		Driver	£1·0
			£6·0

As one would expect, the farmer's lorry on average cost less than the contractor—otherwise the farmer would presumably not have invested capital in one. A lorry is, of course, worth while only if the farmer has sufficient use for it, not only in the sugar beet season but at other times of the year.

Figure 1.5 Relationship of Labour Input and Yield per acre

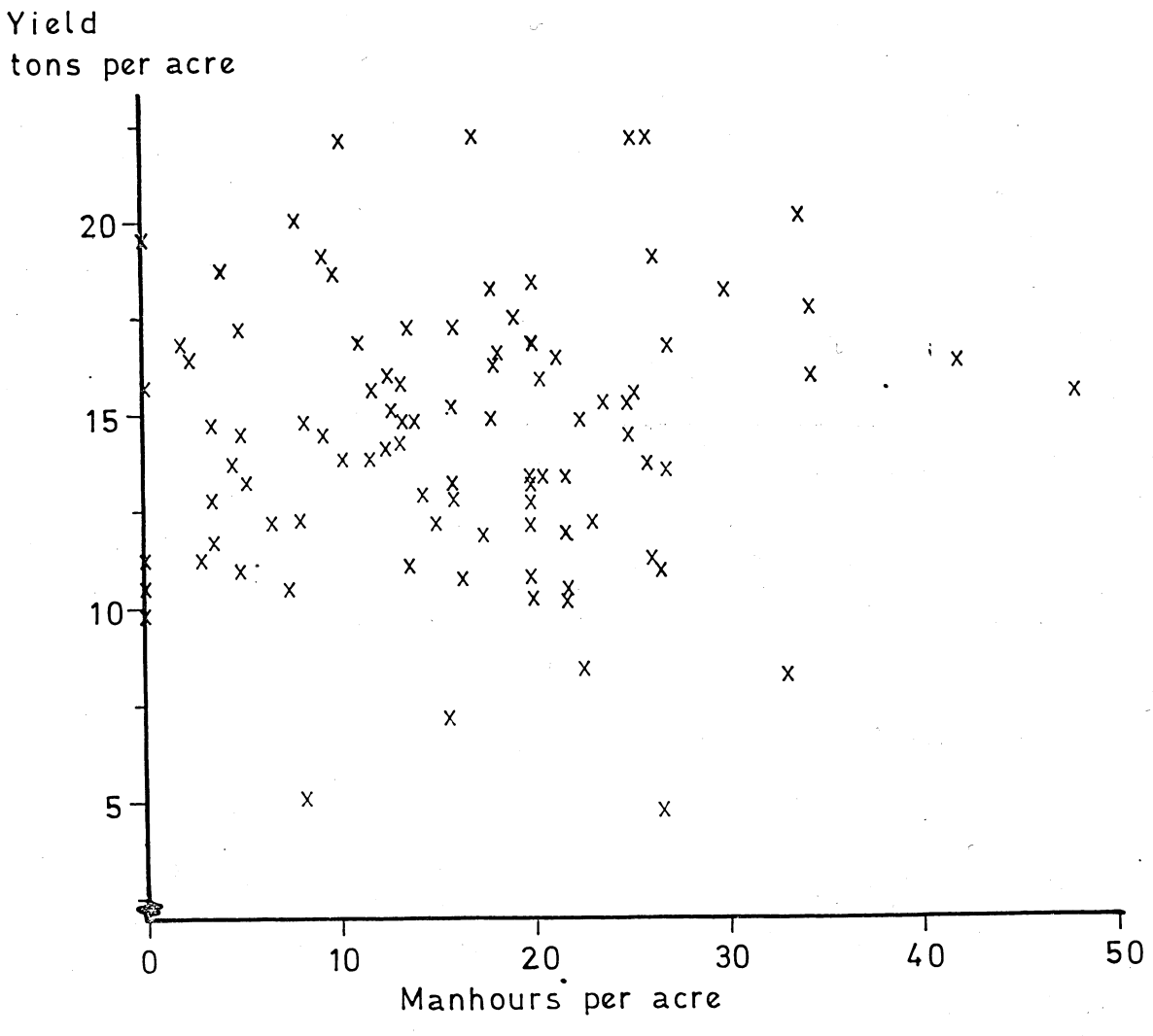
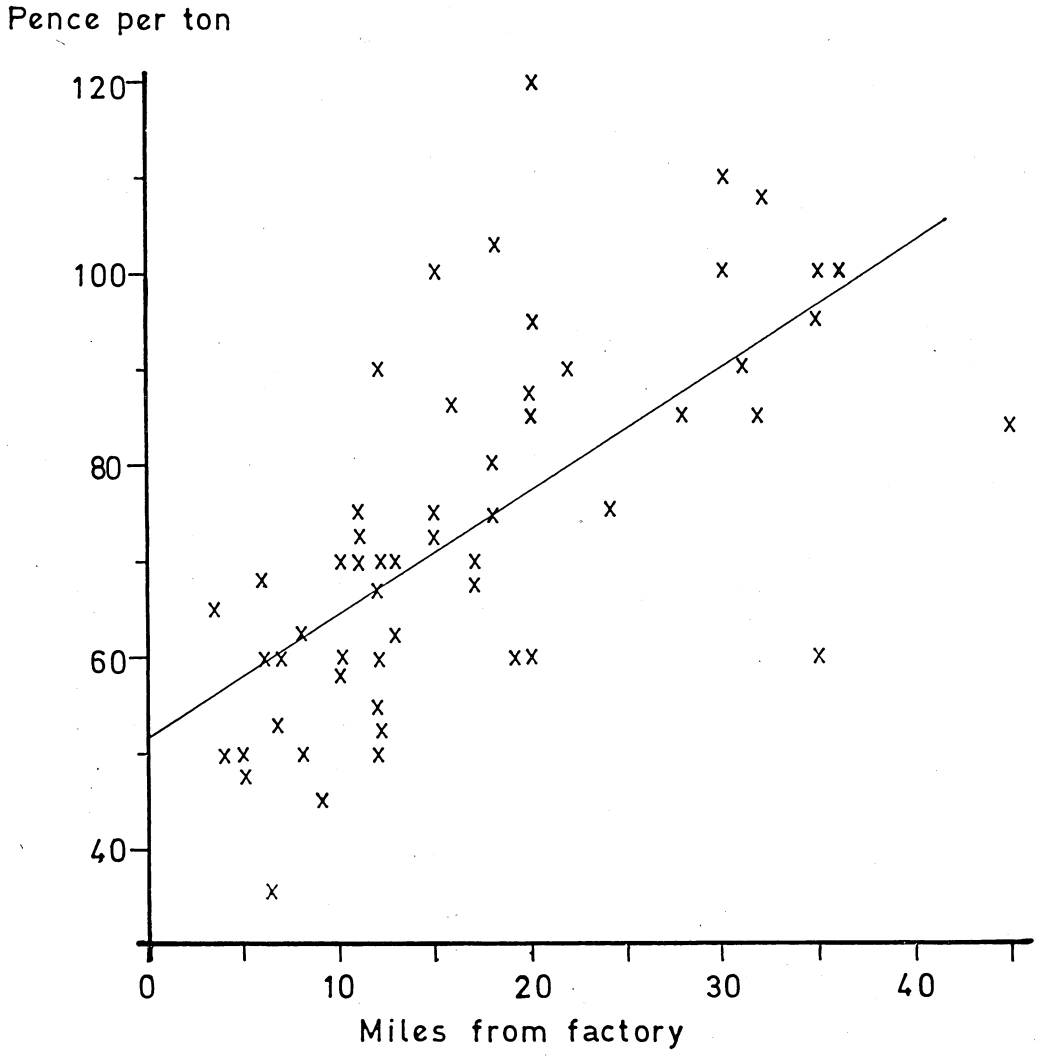


Figure 1.6 Cost of transporting sugar beet (per ton)



Specialised Machinery Costs

The capital value of specialised sugar beet machinery, that is excluding tractors and general purpose trailers, averaged £11·8 per sugar beet acre over the whole sample. This varied from nil, where contract services were used for all mechanical operations, to £41 per acre where new expensive machinery was associated with a relatively small acreage of sugar beet.

There were a number of shared harvesters in the survey, particularly associated with multi-row, multi-machine systems.

The cost for specialised machinery per sugar beet acre was taken as 20 per cent depreciation of the 1970 opening valuation plus the total repair bills for 1970; this total being divided by the sugar beet acreage handled. This cost averaged £3·7 per acre with a range of observations from nil to £15·7 per sugar beet acre. It was very noticeable, however, that only 14 farmers of the 104 recorded had a figure higher than £6 per acre. None of these 14 farmers however used multi-row harvesters. The high cost reflected the recent purchase of new harvesters and the consequent high depreciation charge in that year.

CHAPTER 2

Implications of Growing More Sugar Beet

Sugar Beet and Sugar Cane

In considering the wider implications of growing more sugar beet in this country or importing, there are a number of aspects to be considered—some economic and some political. It may be asked why the production of sugar is not left to market forces. If so, the crop would be grown in countries with a natural advantage and low costs of production. Sugar would be imported by other countries whose climate was less suited to the crop. Unfortunately there seems to be no likelihood whatever of this happening. The reasons are several:—

1 Sugar grown for the home market is often protected and farmers have a vested interest in seeing that such protection is continued. The E.E.C. and the countries from which it was formed have protected sugar beet for many years. There can be little doubt that in consequence, many uneconomic sugar industries have been sustained artificially; for example, sugar cane in Louisiana, where the winters are rather cold for the crop, could hardly survive without protection by the U.S. government.

2 Nearly all the exporting countries have bilateral marketing arrangements with importing countries. In some cases, these are between former colonies or overseas territories and the mother country e.g. U.S.A. and Puerto Rico, France and Guadiloupe, Réunion and Martinique, Portugal and her African territories, the U.S.S.R. and Cuba, and the U.K. and Commonwealth countries. Most of the exporting countries in this category are developing countries who put a high value on a guaranteed market and price. When world prices have been high, the Commonwealth Sugar Agreement has secured us supplies at a modest price. Over most of the period since 1951, the C.S.A. price has been above world prices, thus furnishing a subsidy to developing Commonwealth countries. During most of 1971/2, however, the world price has been above the C.S.A. price.

3 As already mentioned, World Market prices have been highly unstable and have often remained for long periods far below the lowest cost of production in any country.

There are two main reasons for these fluctuating prices. The first is that the demand for sugar is inelastic. This means that shortages and surplusses tend to have a more than proportionate effect on prices. The second is that the 'World Market' is a residual market for only about one-eighth of world production. As a result, fluctuations in demand and supply tend to be passed on to this comparatively small market and thus have an exaggerated effect on prices. As a result no developing country could in the past have depended on selling sugar in such a market.

It is true that since 1968, the International Sugar Agreement has helped to increase prices although they are still very variable. Even so, developing countries are unlikely to wish to leave the protection of their present bilateral agreements until they can be quite certain that the International Agreement can be relied upon as a permanent arrangement.

If complete free trade in sugar is not practicable, on what principles should British policy be based? Until now, the choice has been between beet sugar grown here and cane sugar imported from the Commonwealth. It is sometimes argued that sugar cane is inherently the more economic form of production and for this reason should have the lowest costs. Grogan[1] for example, gives three reasons:—

1 The yield of sugar beet per acre is less than that of cane.

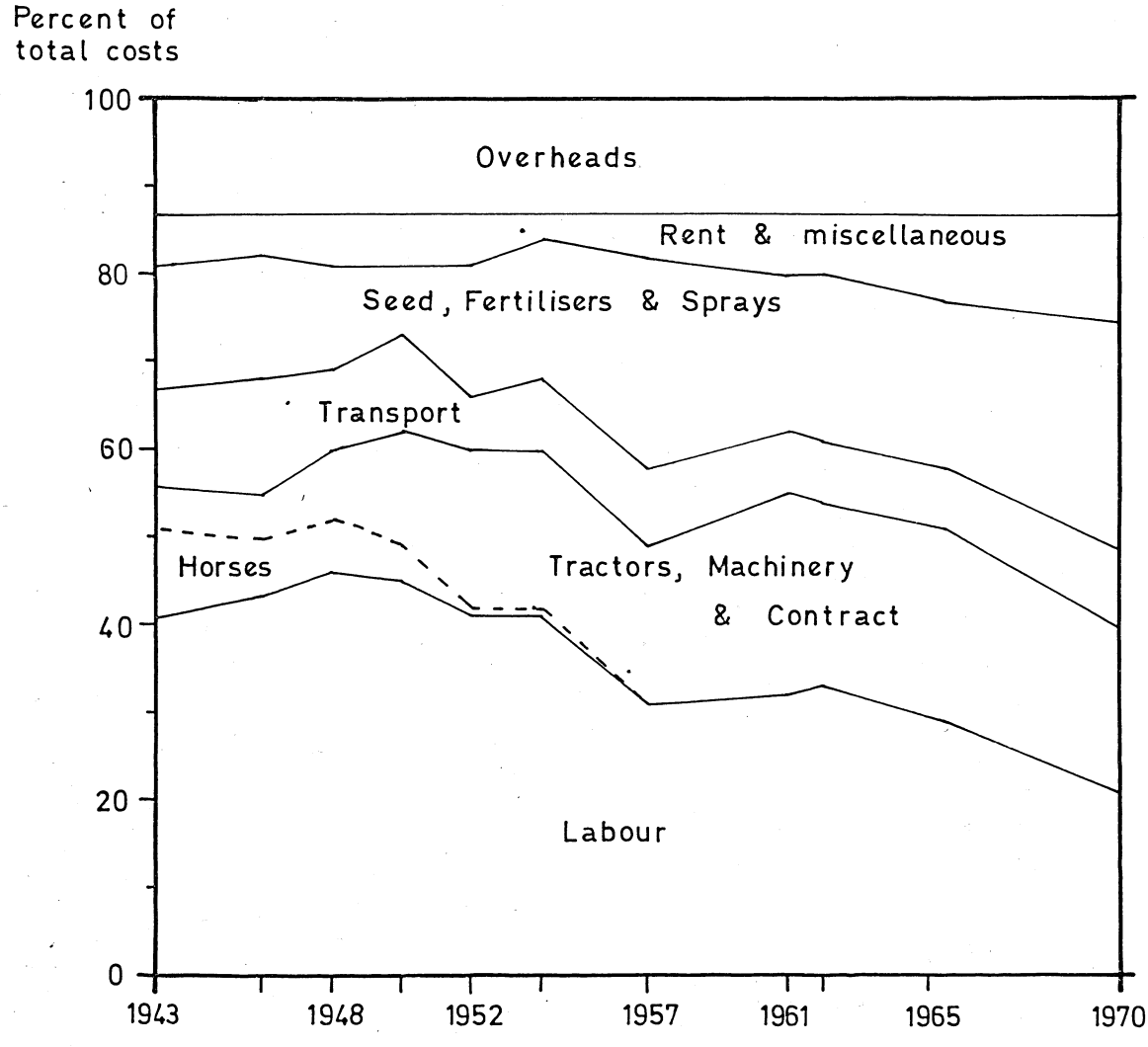
2 Sugar cane (unlike beet) can be grown year after year on the same soil. Plantations can therefore be concentrated close to the factory, thus reducing the cost of transporting cane to the factory.

3 Sugar cane is a perennial and unlike beet does not have to be sown every year.

[1] F. O. Grogan, International Trade in Temperate Zone Products.

None of these are fundamental points. Yield per acre is only one of many factors that determine the cost of production. It is true that in Australia cane yields over four tons of sugar per acre compared to two tons from beet in England. But in the case of wheat, the position is exactly reversed, English wheat has more than twice the yield of Australian wheat but these yields do not make Australian wheat or English beet 'uneconomic'. So long as marginal returns cover marginal costs, any crop is worth growing unless there is a more profitable alternative. Any surplus above the minimum necessary to induce the crop to be grown will tend to be reflected in the rent or value of the land. For this reason, one finds sugar being grown in countries with widely different yields per acre. For example, cane in the Phillipines or Cuba yields only about half as much per acre as in Australia but both are major exporting countries.

Figure 2.1 Changes in distribution costs: sugar beet 1943–1970



It is true that in order to prevent eelworm disease, beet should not be grown in the same soil more often than once in about four years. For this reason, beet crops are more scattered than cane. But this

fact does not cause difficulties in transport. On the assumption that 60 per cent of the area round a factory is arable land and that 10 per cent of this is in beet, even a large factory processing 90,000 tons of sugar could have the crop grown within a radius of 20 miles. In fact, the difference in cost of transport between, say, 10 and 20 miles is only 12p per ton or about 2 per cent of the receipts. Sugar beet is easy to handle and in our cool climate can be stored if need be until transport is available. By contrast, cane is often difficult and expensive to move on poor roads in tropical conditions where cane deteriorates rapidly after cutting.

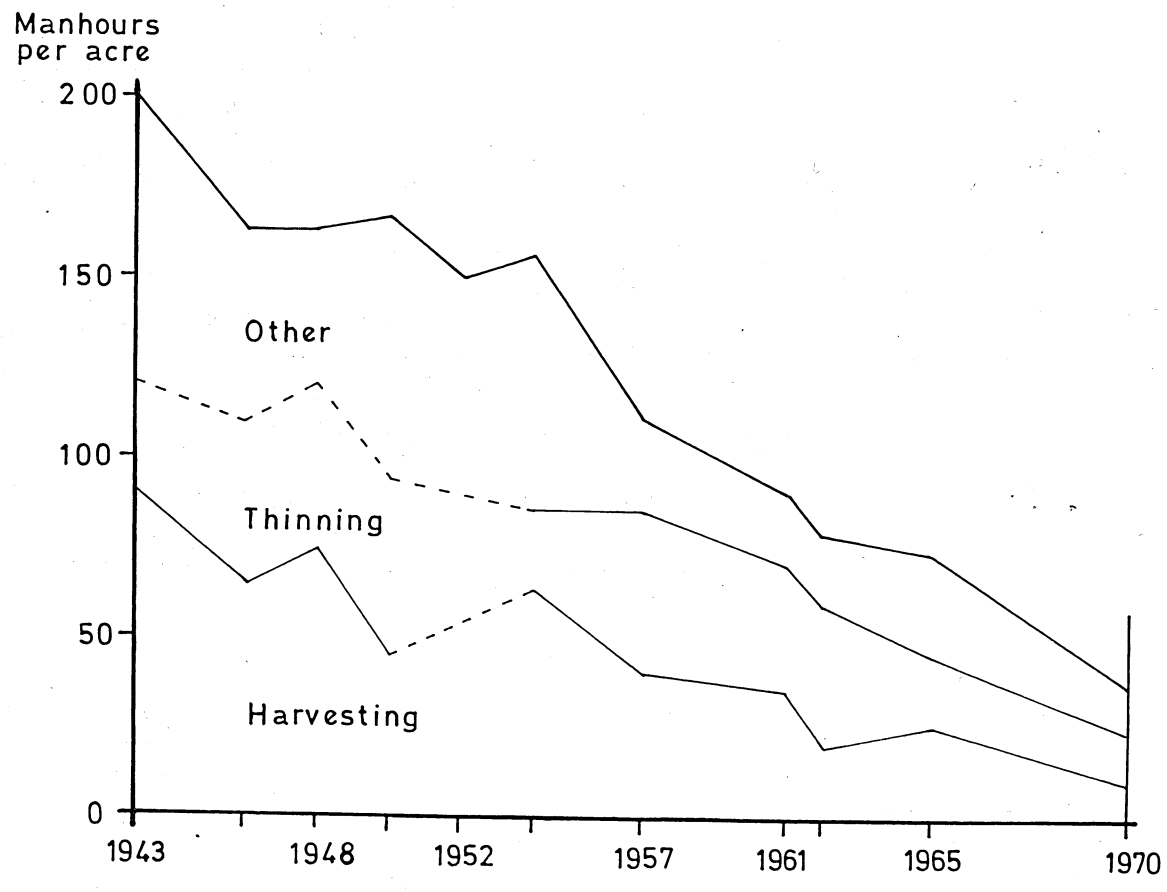
The remaining point—the relative cost of planting and sowing seed is a small matter and can be taken as part of the total cost of growing the crops mentioned later.

On the other hand, imported cane sugar suffers from several cost disadvantages in comparison with sugar beet grown for home consumption.

1 Cane sugar has to be loaded and shipped to this country. Beet sugar is already here.

2 Imported sugar is processed abroad into raw sugar. This is then redissolved and refined in this country. Home grown beet sugar can be processed and refined in a single operation which is less expensive.

Figure 2.2 Decline in man-hours per acre for sugar beet 1943–1970



3 Cane sugar plantations are usually monocrop. For this reason, labour requirements are uneven and a large proportion of the workers can be employed for only a few months in the year. Much of the cultivating equipment also stands idle for a large part of the year. Sugar beet by contrast is part of a mixed arable system with a variety of crops and livestock that provide employment for labour and much of the machinery throughout the year. A combination of enterprises also provides a broad base to carry overhead costs.

There can be little doubt that the economics of sugar beet production have altered fundamentally in the past thirty years. This is illustrated in Figure 2.1 based on enterprise studies carried out at Cambridge since 1943. It is interesting to note that costs have changed in relative importance. In 1943, labour accounted for 41 per cent of the total. At that time, sugar beet was a labour intensive crop and with our relatively high wage rates was obviously at a disadvantage compared to sugar cane grown in the tropics with lower wage rates. By 1970, labour accounted for only 21 per cent of costs. Differences in wage rates between this country and those from which we import are thus of less importance.

By contrast, materials now account for a larger proportion of the total. Sprays and fertilisers have risen from 12 per cent to 21 per cent. Seed has increased from 2 per cent to 5 per cent of the total due to the introduction of pelleted and monogerm seed. The increased expenditure on sprays and seed is to a large extent a substitute for labour.

Changes in labour requirements are shown more precisely in Figure 2.2. Overall, man hours per acre have dropped from 200 to 36. The steepest fall is in harvesting from 89 to 10. As mentioned elsewhere, this is due to mechanisation, particularly since 1954. Although the total is still falling, the figure is now so small that further economies are bound to be small. Man hours for thinning have fallen from 32 to 13. This item will undoubtedly decline further as techniques now coming into use are perfected.

It is to be regretted that although costs of production in England are freely published, those for cane producers are not readily available. Costs are collected by members of the C.S.A. for submission to the British Government but are regarded as confidential. One of the authors was, however, a member of a Royal Commission on the sugar industry in Jamaica and was able (from data published in the Commission Report) to make a comparison between costs in Jamaica and England from 1954 to 1965. These costs for Jamaica are included in Table 2.1 together with an estimate for 1970. It will be seen that in 1954 cane costs per ton of sugar were substantially below those of sugar beet.[1] By 1965, the gap had almost closed and by 1970, the two costs were almost identical.

Table 2.1 Costs of Production—Jamaica and England

Year	*Cost per Acre*	*Cost per Ton*	
	Sugar Beet (England) £	*Sugar Beet (England)* £	*Sugar Cane (Jamaica)* £
1943	34·3	25·6	n.a.
1952	55·0	34·2	n.a.
1954	58·4	40·6	22·8
1961	69·5	36·8	30·9
1965	70·5	35·6	34·5
1970	83·1	42·4	42·5
Increase 1954/1970	+42%	+4%	+86%

n.a. = not available

[1] For further details, see: Sturrock, F. G., Sugar Beet or Sugar Cane? *Journal of Agricultural Economics*, XX, p. 125, 1969.

The reason is that although costs per acre in England had increased by 42 per cent since 1954, this was largely offset by an increase in yield of 36 per cent. In consequence, costs per ton increased by only 4 per cent. In Jamaica, costs of wages and other items increased substantially and as yields were almost static, costs per ton increased by 86 per cent.

These costs are for growing, harvesting and transporting the two crops to the factory gate. Apart from the fact that cane is crushed with rollers and the beet is sliced, the extraction process is similar. As already mentioned, however, imported cane sugar requires an extra stage in refining as it has to be shipped to this country. These two items (which do not apply to beet sugar) add about £6 per ton to the cost of cane sugar. It is thus apparent that beet sugar grown in England costs appreciably less than cane sugar delivered to this country from Jamaica.

This is, of course, a comparison with only one country. Costs in developed cane producing countries such as Australia and South Africa are believed to be less than in Jamaica. As we are joining the Common Market, however, it seems unlikely that we shall be able to continue to import sugar from Australia except with a large levy. On the other hand, we may be able to continue to import supplies from the West Indies and other undeveloped Commonwealth countries.

The Place of Sugar Beet in British Farming

As is well known, the area of sugar beet that a farmer can grow depends on his contract with the British Sugar Corporation. Many farmers would willingly grow more if they had the opportunity because the crop is one of the most profitable on the arable farm. In particular, it has a much higher gross margin (say £75 per acre) than barley (say £30). It thus follows that a change from barley to sugar beet would increase returns by £45 per acre provided there were no increase in fixed costs.

There is in fact very little evidence that fixed costs would be appreciably increased by growing more sugar beet. None of the farmers on this survey who wished to grow more sugar beet would have employed more labour and nearly all of them had harvesters and seed drills large enough to deal with the extra acreage they desired. Ten per cent of the farmers stated that they would change their equipment but most of this would take place in any case. Additional costs for the wear and tear of tractors and other equipment while working on beet will be largely balanced by savings on cultivating cereals or other crops displaced. The addition to fixed costs is thus likely to be minimal. Farmers are thus able to recover in increased profits, most of the differences in Gross Margins between sugar beet and other crops such as cereals—and they are well aware of this fact.

Quite apart from profit per acre, there are other advantages in growing sugar beet that should be taken into account:—

1 The proportion of cereals on arable farms has been increasing rapidly in the last twenty years. Farmers who at one time would have hesitated to grow one cereal crop after another commonly grow two, three or more in succession. There are even attempts to grow barley continuously and to take winter wheat after winter wheat, thus leaving very little gap between one crop and the next. This has led to an increase in disease and even when resistant varieties are bred, there is a constant danger that new strains of pathogens will appear that can overcome this resistance. The tendancy to grow more grain crops is likely to be reinforced by the expected increase in cereal prices when we join the E.E.C.

The arable areas of England are thus in urgent need of profitable break crops to allow the soil a rest between cereal crops. Apart from vegetables which can be grown in only a limited area, the most profitable break crops are sugar beet and potatoes. The demand for potatoes is, however, tending to decline. The other alternatives are beans or leys which are much less profitable than sugar beet and generally less profitable than cereals. Oilseed rape is likely to become more profitable if we join the Common Market but will be less so than sugar beet. It is also believed to harbour sugar beet eelworm which makes it less suitable for a grower who already has some sugar beet.

Table 2.2 Gross Margins

	Per annum
Break crops to replace cereals:	£
Sugar beet	75
Potatoes	85
Field beans	25
Oil seed rape (winter)	25
Leys for cattle or sheep	15 to 25 (variable)
Cereals:	
Wheat	40
Barley	30

2 Traditionally, one of the chief advantages of growing a root crop such as sugar beet was that it allowed the farmer to clean the land and suppress weeds. Although with modern herbicides the farmer is less dependant on cleaning crops, there are nevertheless weeds such as couch or black grass that are difficult or expensive to kill in a cereal crop. Sugar beet thus still has a value as a cleaning crop.

3 Over the years, the labour requirements of sugar beet have fallen dramatically (see Figure 2.2). One result is that sugar beet is much more attractive to farmers in areas (e.g. Midlands) where labour is scarce. It is noticeable that in some factory areas where insufficient beet was grown a few years ago and supplies had to be transported from East Anglia, local growers are now taking up the whole of the local quota.

4 Sugar beet is complementary to cereals in labour requirements. The busy periods for barley are February to March for sowing, and August to September for harvesting. For sugar beet they are April to early June for seedbed preparation and thinning, and September to January for harvesting. There is some competition in September between sowing winter wheat and the beginning of the sugar beet harvest but apart from this, cereals and sugar beet fit well together as the basis for a rotation.

This point has some important implications in practice. There are many cereal growing specialists with 80 per cent or more of their land in cereals. Some of these are on very heavy land or on thin soil that would not suit sugar beet. Others, however, are on good land. They specialised on cereals when land was cheap and the mechanisation of cereal seemed the way to obtain a high output per man and per unit of capital. Thirty or forty years ago, sugar beet would have been regarded as a nuisance on such a farm requiring far more staff than was required for the cereals and would have complicated the simple routine of the grain specialist.

Now the position has changed. Land is expensive and to justify the capital invested, a larger return is necessary on good land than can be obtained from cereals alone. There is thus a move to intensify and now that sugar beet is mechanised, it can be added to the cereal specialists' rotation, increasing total output without any addition to the permanent labour force. Indeed, it should be possible for a well mechanised grain farm with 400 acres of cereals per man to add up to 40 acres of sugar beet with the same labour force. Unfortunately, such farmers have no quota for sugar beet or a smaller one than they would like to have.

To illustrate the effect that sugar beet can have on the economy of a farm Table 2.3 has been extracted from the 1971/2 Farm Management Survey now nearing completion at Cambridge. The sample includes 136 arable farms of which 74 (Group A) have sugar beet and 62 (Group B) have none. The Trading Account has been set out in a form designed to be useful to A.D.A.S. officers and farmers. To allow simple comparisons between groups, the results are shown 'per 100 acres' farmed. It will be seen that each enterprise is shown as

Acres × Gross Margin per acre = total Gross Margin.

The gross margins are then totalled and fixed costs (labour, machinery, rent and other overheads) are deducted to give the net farm income. It will be seen that, apart from sugar beet, the two groups are reasonably alike. The size (360 and 342 acres), the rent per acre (£8) and the gross margin per acre of cereals (£40) are all closely similar. The main differences are:—

1 The A farmers (with sugar beet) have rather more potatoes and horticultural crops (peas, beans for market, etc.). The B farmers have rather more cereals, beans and 'other crops' such as grass seeds. Neither group (by definition) has much livestock.

Table 2.3 Cropping Farms—With and Without Sugar Beet (East Anglia)
(Gross Margins, Fixed Costs and Profits per 100 acres, Eastern Counties)

	A. With Sugar Beet			*B. No Sugar Beet*			
1971 *Harvest Year*	*Acres*	*G.M. per acre*	*Total G.M.*	*Acres*	*G.M. per acre*	*Total G.M.*	*Difference A–B*
Gross Margins:							
Wheat	32	51	1,609	34	50	1,685	— 76
Barley	31	30	927	35	31	1,090	—163
Oats	2	36	87	3	37	125	— 38
Cereals	65	40	2,623	72	40	2,900	—277
Beans	3	20	68	7	16	121	— 53
Potatoes	4	97	384	2	68	116	+268
Sugar beet	11	96	1,073	—	—	—	+1,073
Horticulture	5	43	212	3	37	111	+101
Other crops	4	10	39	9	20	178	—139
Total crop	92	48	4,399	93	37	3,426	+973
Cattle and sheep	4	29	118	3	38	116	+ 2
Pigs and poultry	—	—	27	—	—	88	— 61
Miscellaneous	4	—	207	4	—	163	+ 44
Total Gross Margin	100	47	4,751	100	38	3,793	958
Fixed Costs:							
Labour		10	1,004		7	745	—259
Machinery		11	1,097		9	913	—184
Rent		8	810		8	754	— 56
Other overheads		3	314		3	282	— 32
Total Fixed Costs		32	3,225		27	2,694	—531
Net Farm Income		15	1,526		11	1,099	+427
Number of farms			74			62	
Average size			360			342	
Acres sugar beet			40			—	

Note: Gross Margins per acre and acres are rounded to the nearest whole number.

2 In total, Group A has a total gross margin of £4,751 compared to £3,793 for Group B. This difference (£958) is largely accounted for by the contribution of sugar beet (£1,073) to Group A. These are, of course, the results for only one year and one in which yields and returns for sugar beet and wheat were above average. As prices for these products are higher in the E.E.C., the gross margins are however nearer the levels to be expected if we join that organisation.

3 The A farmers being more intensive spend £531 more on fixed costs—principally on labour and machinery. On balance, the profit of the A farms is £427 per 100 acres or 39 per cent more than the B farms. A large part of this is attributable to the sugar beet.

4 These are averages. Nonetheless, they portray fairly accurately the organisation of the two farm types of most interest in sugar beet growing. Type A would be classified by the M.A.F.F. as 'General Cropping' and 88 per cent of such farms in the Eastern Region grow sugar beet. Type B would be classified as 'Mostly Cereals' and 57 per cent of those in the Eastern Region do not grow sugar beet.

5 Many of the B farms would welcome a contract for sugar beet. Would they then resemble the Group A farms? Not in every particular. The B farms, for example, carry about one man less per farm but would be most unlikely to recruit extra workers simply to grow sugar beet. With a contract for, say, 30 acres of sugar beet replacing cereals, the extra gross margin might be no more than £1,200 which would be swallowed up by the wages of a man and the upkeep of a beet harvester. There can be little doubt that such farmers would contract for only as much beet as could be managed by existing staff. To do so, they might simplify farm systems by giving up some minor crops such as potatoes, whose harvesting conflicts with sugar beet and grass seeds which are less profitable. With a good break crop such as sugar beet, they would be tempted by high E.E.C. prices to try to grow more wheat. In these circumstances, the B farms would be fully as profitable as the A farms.

The Effect on the Output of Agriculture

Another point of more general interest, is whether an increase in sugar beet would imply a reduction in other output. Most farmers on this survey who wished to grow more beet stated that it would displace barley. If we assume an increase of 100,000 acres, this would mean a reduction of 2 per cent in the present barley acreage of 5m. in England and Wales. This is negligible. It is moreover argueable that the beneficial effect on yields of cereals following sugar beet could well result in no net reduction in the output of cereals.[1]

If this is true, then an increase in sugar beet would be a net addition to the agricultural output of this country. In addition, each acre of sugar beet would furnish 1·3 tons of sugar beet pulp with a feeding value of 1·1 tons of barley.

There would also be up to 12 tons of tops suitable for feeding. If half of this were fed, this would be worth the equivalent of up to 10 cwt. of barley. Sugar beet pulp and tops are, of course, most suitable for sheep or cattle. Nonetheless, the by products of sugar beet produce nearly as much fodder for cattle or sheep as the barley displaced—in addition to sugar for human consumption.

It is possible that some farmers growing both potatoes and sugar beet might give up potatoes and concentrate on sugar beet. This could save the farmer from the need to carry two different types of harvesting and other equipment. This need not result in a reduction in potatoes grown because there are other farmers who would grow more potatoes if they were not restricted. Indeed, there might be some advantage if the south east of England concentrated rather more on sugar beet and left some of the potato acreage to their colleagues further north—for example, at Cupar to compensate for the loss of their sugar beet factory.

[1] If an arable farmer with 70% of his arable land in cereals increased his quota of sugar beet from 8% to 10%, this would mean a reduction of cereals to 68%. An increase in cereal yields of 3%, say from 32 cwt. to 33 cwt. per acre, would give the same total yield of barley.

So far, the effect of increasing the acreage of sugar beet has been stated in husbandry terms. It is perhaps worth restating the implications in conventional economic terms. Under conditions of free competition, the size and combination of crops on arable farms will tend towards an optimum. Farmers would therefore tend to include the acreage of sugar beet that most efficiently utilises the land, labour and capital available. Under present conditions, farmers are prevented from reaching this level. If the present restrictions on sugar beet were relaxed, cropping plans would move towards an optimum leading to more efficient uses of resources. On theoretical grounds, therefore, one would expect the marginal costs of the additional output of sugar to be low. It would not be difficult to demonstrate this point with a series of programmed models.

British Sugar Beet in the E.E.C.

Sugar is the only crop in the E.E.C. for which production is restricted. At present the British farmer is restricted to the acreage named in his contract and he can send to the factory whatever tonnage he can grow on this area. In the E.E.C., the farmer is virtually restricted to a quantity of sugar. This is done by giving the farmer a basic quota of so many tons at, say, 16 per cent sugar. If the sugar content is high, say 17 per cent, the basic quota is reduced and if the sugar content is low, the quota is raised There are some further points:—

1 The farmer receives the full price for his basic quota. If he exceeds the quota by up to 35 per cent, he receives a lower price for the excess. No payment is necessarily made for beet exceeding the quota by 35 per cent.

2 Carriage is normally paid by the factory and the farmer receives a free quota of sugar beet pulp.

Although there is a quota of sugar for each country, there is some latitude in the way in which the regulations are applied within each country. A few examples based on the German regulations are given to show how the British farmer might be expected to fare under such regulations. These are however merely illustrative because details for this country have still to be decided.

Table 2.4 Comparison of Sugar Beet Receipts under U.K. and E.E.C. Regulations

Assume that a farmer is given a basic quota of 1,000 tons and a maximum quota of 1,350 tons (135% of basic quota)

	Quota Not Exceeded			*Quota Exceeded* (*Sugar* 16%)		
	Average Sugar	*Low Sugar*	*High Sugar*			
Farmers' Receipts under E.E.C. Conditions:—	16%	15·5%	17%	By 10%	By 35%	By 50%
Weight of sugar beet grown	1,000 tons	1,000 tons	1,000 tons	1,100 tons	1,350 tons	1,500 tons
Receipts						
(a) Basic quota	1,000 tons @ £7·48	1,000 tons @ £7·145	900 tons @ £8·15	1,000 tons @ £7·48	1,000 tons @ £7·48	1,000 tons @ £7·48
(b) Basic to maximum quota	—	—	100 tons @ £4·40	100 tons @ £4·40	350 tons @ £4·40	350 tons[3] @ £4·40
Value of dried pulp[1]	950	950	950	1,040	1,220	1,220
Average receipts per ton	8·43	8·09	8·72	8·15	7·58	6·83
Total receipts E.E.C.	£8,430	£8,095	£8,725	£8,960	£10,240	£10,240
Total receipts U.K.[2]	£7,000	£6,640	£7,720			

U.K. price £8·0 per ton at 16% (±9% per 1% sugar content)

Price source: M.A.F.F. translation of a German Contract and April 1972 price agreements.

[1] Dried pulp—4·75% of weight of crop @ £20.
[2] Transport. £1 per ton clean beet deducted from U.K. receipts.
[3] 150 tons exceed quota so are not *necessarily* purchased.

Table 2.4 column 1 shows that with 16 per cent sugar, a farmer growing his basic quota would obtain more than under the English system. Column 2 shows the effect of a lower sugar content. Receipts per ton fall but are still above the English level. Column 3 shows the effect of a higher sugar content (17 per cent) assuming that the yield is still 1,000 tons. The basic price rises but the quota is reduced to 900 tons, the last 100 tons being paid at a lower price.

Columns 4 and 5 show the effect of exceeding the basic quota by 10 per cent and 35 per cent due to an exceptionally high yield or by deliberately growing a larger acreage. Total receipts are substantially increased. In column 6 the quota is exceeded by 50 per cent—the last 15 per cent would receive no payment. In this case, it would pay the farmer to feed the surplus to livestock.

Under the present British system, the acreage of sugar beet is limited but the tonnage is not. Farmers thus try to obtain high yields because this is the way to maximise their total receipts. They therefore tend to apply fertilisers to the economic limit and often beyond. Research workers also concentrate nearly all their attention on obtaining the maximum yield. But under the E.E.C. regulations, the limit is on tonnage. The farmer will therefore obtain the same receipts whether he grows this quantity intensively on a small acreage or extensively on a larger one. The possibility of 'ranching' sugar beet and accepting a lower yield might appeal to farmers short of labour. Some, for example, might be more ready to take a chance on drilling to a stand and use little or no hand hoeing. Others might be less lavish in the use of fertilisers. It is to be hoped that experiments to explore the economics of such alternatives will be undertaken by the Husbandry Farms of N.A.D.A.

Some of the possibilities can be examined now. Suppose, for example, that a farmer now grows 60 acres (Table 2.5 No. 1) and obtains 16 tons per acre (i.e. 960 tons). He has been given a quota of 960 tons and is considering the possibility of cutting labour and fertiliser by £10 an acre and growing it on 80 acres @ 12 tons (No. 2). This will mean displacing 20 acres of barley. The implications are shown most easily by calculating the total gross margin from 80 acres.

Table 2.5 The Effect of Spreading a Sugar Beet Quota over More Acres (E.E.C. Conditions)

	Alternatives	*Output* £	*Per Acre Seed, Sprays, Fertiliser* £	*Gross Margin* £	*Total Gross Margin* £
1.	60 acres sugar beet @ 16 tons	135	35	100	6,700
	+ 20 acres barley			35	
2.	80 acres sugar beet @ 12 tons	101	25	76	6,080
3.	80 acres sugar beet @ 14 tons	112	29	83	6,640
4.	80 acres sugar beet @ 16 tons	122·5	35	87·5	7,000

Quota 960 tons. Price £7·48 + 4·7% sugar beet pulp.
Over 960 tons. Price £4·40 + 4·7% sugar beet pulp.

In this case, a change to 80 acres @ 12 tons means a loss of gross margin of £620 (£6,700 — £6,080). To put the proposition in another form, he has grown the same tonnage of beet on a larger acreage and has spent £100 less on fertiliser and sprays and seed. On the other hand, he has lost £700 gross margin from 20 acres of barley foregone. The farmer need not however be content with a yield of 12 tons. With a little more care and fertiliser, a yield of 14 tons might be obtained on the 80 acres (No. 3). The extra 2 tons is of course in excess of the quota and will obtain a lower price. In this case, the total gross margin is £60 less than the original. The farmer might go a stage further and consider intensifying the whole 80 acres (No. 4). If he obtains 16 tons per acre, 4 tons of this will be at the lower price. On balance, the result shows a gain of £300 over the original (No. 1). To put the matter

in another way, the first 60 acres obtains a gross margin of £100 per acre as in case 1. This uses up the quota and the beet from additional acres can be sold for only £4·40 per ton. Allowing for the pulp, this is equivalent to a gross margin of £50 per acre—only £15 more than the barley displaced. The net gain is thus 20 acres × £15 = £300.

There are, however, other possible benefits from growing a larger area of sugar beet. If the farmer could follow the extra 20 acres of sugar beet by wheat instead of barley (say, an extra £10 gross margin per acre = £200) and if an additional break crop produced increases in yield elsewhere in the rotation, this could be added to the returns for cases 2, 3 and 4.

CHAPTER 3

The Feasibility of Increasing Sugar Production

The Scope for Increased Production

If more sugar beet is grown in this country, where is this likely to be? There are three possibilities:—

1 Many existing growers would like to grow more.
2 Many farmers near the existing factories with no contract would like to grow the crop.
3 A new factory could be erected in an area suitable for the crop.

Existing Growers

Growers contacted on this survey were asked whether they would like to grow more sugar beet and, if so, how much. Of 103 growers, 66 wished to grow more beet and 37 did not. As might be expected (Table 3.1) farmers with a low proportion of beet showed rather more enthusiasm for growing more.

Table 3.1 Intensity of Production and Desire to Grow more Sugar Beet

	Wish to Grow more Beet		
Sugar Beet as Percentage of Arable	*No*	*Yes*	*Total*
0–10	3	9	12
10–20	19	46	65
Over 20	15	11	26
	37	66	103

Table 3.2 Size of Farm and Desire to Grow More Sugar Beet

Farm Size (acres)	*Additional Acreage of Sugar Beet Desired*						*No extra Sugar Beet Desired*
	No.	*Sugar Beet as Percent: of Farm*	*of Arable*	*Acres Now*	*Extra Acres*	*Desired Percent*	*No.*
Up to 250	21	13·5	15·2	18·4	6·7	36·4	16
250–500	22	13·9	15·9	49·6	16·8	33·9	15
Over 500	23	12·3	14·1	119·5	39·7	33·2	6

It can be seen from Table 3.2 that farm size appears to make little difference to the desire for more sugar beet. All three size groups (up to 250, 250–500, over 500 acres) have about 15 per cent of their arable land already in sugar beet and all desired to increase this by about 33 per cent. If we include the farmers who did not desire a larger contract, the increase in acreage desired was 23·8 per cent. An increase of 24 per cent on an acreage of 450,000 is 108,000 acres. In other words, if this survey is accepted as typical, existing growers would be willing to grow an extra 100,000 acres.

New Growers Near Existing Factories

An estimate of the number of growers willing to start growing sugar beet can be derived from the Farm Classification carried out by the Ministry of Agriculture, Fisheries and Food. The types of farm already growing beet are shown in Table 3.3.

Table 3.3 Types of Farm Growing Sugar Beet (England and Wales)

Farm Type	*Farmers with Sugar Beet*				*All farms*	
	No. Farms	*Sugar Beet Acres*	*S.B. per Farm Acres*	*Percent with S.B.*	*No. Farms*	*Average Size*
General Cropping	9,593	309,165	32·2	65·6	14,619	265
Cropping, mostly cereals	1,824	42,494	23·3	20·1	9,053	350
Mixed	1,478	36,052	24·4	11·9	12,471	235
General horticulture	1,432	23,366	16·3	15·0	9,571	53
Part time holdings	4,286	16,077	3·7	4·2	100,879	25
Mainly dairy	553	8,092	14·6	2·8	19,960	161
Pigs and poultry	526	8,500	16·2	9·4	5,620	74
Others	488	6,314	12·9	0·8	57,779	124
	20,180	450,060	22·3	8·8	229,952	103

In all, 20,180 farmers grow sugar beet. Of these, nearly a half (9,593) are classed as 'General Cropping' farmers. This is the type that grows most of the crop. It will be seen that two-thirds of them grow sugar beet and in total they grow two-thirds (309,165 acres) of the total acreage (450,060).

The next most important is the 'Cropping, mainly Cereals' type that accounts for 42,494 or 9 per cent of the acreage. A fifth of this group grow sugar beet. Farmers in this group that do not grow beet fall into two types—some are on land that is too heavy or light to grow root crops, others are on good soil and would gladly grow more beet if they had a quota (see Chapter 2b for discussion of this point).

The third most important group are the 'Mixed Cropping' farmers with 36,052 acres. Many of them resemble the 'General Cropping' farms but have more livestock. Twelve per cent of this group have sugar beet.

The fourth group 'General Horticulture' grow 23,366 acres and 15 per cent of the farms have sugar beet. Some of these are specialists on small holdings, others mainly in the Eastern Counties are larger and it is they that grow most of the sugar beet. Next follow the part time holdings which grow 16,077 acres of beet. This is, however, a group that is dwindling as holdings are amalgamated. Next is the 'Mainly Dairying' group that, especially in the Eastern Counties, often have arable land on which they grow sugar beet. (The Dairy Specialists are a separate group and usually have very little land to spare for cash crops.) Many of the 'Pig and Poultry' farms are specialists without much land. Some, however, are arable farms with large pig herds or poultry flocks and also sugar beet. These again are largely in the Eastern Counties.

It is obvious that most of the sugar beet is grown on only a few farm types—especially General Cropping but also Mostly Cereals, Mixed, General Horticulture and (to a limited extent) Mainly Dairying. The others are of minor importance and can be ignored.

There are marked differences between the regions. As can be seen from Table 3.4, the Eastern Region dominates the position with 60 per cent of the total acreage and more than half the farmers grow sugar beet. Nearly 90 per cent of the General Cropping farms and more than a third of the

* Table 3.4 Types of Farm Growing Sugar Beet—by Region

Eastern Region

Farm Type	Sugar Beet (acres) Total	Sugar Beet (acres) Per Farm	Farms With S.B.	Farms Without S.B.	Percent With S.B.
General Cropping	186,682	33·8	5,523	764	88
Mostly Cereals	27,538	24·3	1,135	1,508	43
Mixed	23,059	29·1	792	529	60
General Horticulture	20,446	16·2	1,262	1,990	39
Mainly Dairying	4,046	16·2	249	419	37
Total (including other types)	272,301	28·2	9,652	8,382	53

Counties: Beds., Cambs., Essex, Herts., Hunts., Holland (Lincs.), Norfolk, Suffolk.
Factories: Spalding, King's Lynn, Wissington, Cantley, Peterborough, Ely, Bury St. Edmunds, Ipswich, Felstead.

East Midland Region

General Cropping	68,020	33·2	2,048	614	77
Mostly Cereals	10,981	22·5	488	1,321	27
Mixed	4,871	21·3	229	1,035	18
General Horticulture	1,249	15·4	81	449	15
Mainly Dairying	1,205	13·2	91	1,654	5
Total (including other types)	87,977	28·8	3,055	9,282	25

Counties: Derby, Leicester, Kesteven and Lindsey (Lincs.), Northants, Notts., Rutland.
Factories: Brigg, Bardney, Nottingham, Newark.

West Midland Region

General Cropping	24,180	44·8	540	729	43
Mostly Cereals	1,029	21·0	49	537	8
Mixed	5,220	23·0	227	1,409	14
General Horticulture	992	27·6	36	931	4
Mainly dairying	2,183	15·8	138	2,747	5
Total (including other types)	35,312	32·0	1,102	15,429	7

Counties: Cheshire, Hereford, Shropshire, Staffs., Warwick, Worcs.
Factories: Allscott, Kidderminster.

Lancashire and Yorkshire Region

General Cropping	19,422	18·9	1,029	1,110	48
Mostly Cereals	1,696	18·4	92	992	8
Mixed	1,641	12·9	127	1,069	11
General Horticulture	517	11·5	45	1,279	3
Mainly Dairying	259	6·8	38	2,273	2
Total (including other types)	24,054	17·4	1,385	13,289	9

Counties: Lancs., Yorks., East Riding, West Riding.
Factories: York, Selby.

* These are the regions used in Farm Classification, M.A.F.F. (see frontispiece).
A few farmers growing sugar beet in the Northern Region have been ignored.

General Horticulture and Mainly Dairy grow sugar beet. In the other regions listed, most of the sugar beet is grown on General Cropping farms.

From the lists of farmers not at present growing sugar beet, an estimate has been made of the number that might wish to do so if a contract were offered. The method used can be illustrated as follows. Let us take the first group—General Cropping in the Eastern Region. In this group 5,523 (88 per cent) grow sugar beet and 764 farms do not. If offered a contract, how many of the latter would accept? If they are identical with those already growing the crop and are prevented merely by lack of a quota, we would expect 88 per cent of them to accept. It is prudent however to assume that some have never grown the crop because the farm was unsuitable for some reason. The fairly conservative assumption is thus made that half of them are unsuitable and that of the other half, 88 per cent would accept and grow the same acreage as others in the group already growing the crop. Similar assumptions were made for all the other groups using half the percentage in the last column of Table 3.4 e.g. 21½ per cent of the Mainly Cereal farms, 30 per cent of the Mixed farms not growing sugar beet, etc.

A summary of the estimates is given in Table 3.5.

Table 3.5 Estimates of Additional Sugar Beet for Existing Factories (New Growers)
(Acres)

Type of Farm	*Eastern*	*East Midland*	*West Midland*	*Lancs. and Yorks.*	*Total*
General Cropping	11,357	7,835	7,034	5,027	31,253
Mostly Cereals	7,873	4,005	441	736	13,055
Mixed	4,627	1,981	2,277	761	9,646
General Horticulture	6,286	524	524	219	7,553
Mainly Dairy	1,263	541	1,090	156	3,050
	31,406	14,886	11,366	6,899	64,557

It is thus estimated that contracts could be obtained for approximately 65,000 acres from new growers in existing factory areas.

A New Factory

A number of sites have been suggested for a new factory. One favourite is the south coast behind Southampton which could draw on the whole of the south coast from Cornwall to Kent if need be.

During and after the last war, a substantial amount of sugar beet was grown in this area and sent by rail to the Kidderminster factory in Worcestershire. This is a long distance and for some years transport was subsidised. As local supplies increased in the West Midlands, however, the subsidy was withdrawn and beet growing in the southern counties largely died out. The area grown in each county in 1951 is however of interest as giving some indication of the most popular districts at that time. The total of 18,090 acres should not of course be taken as an indication of the present potential if there were a conveniently placed local factory.

	1951	1971		1951	1971
Surrey	509	93	Wiltshire	714	185
Kent	1,700	49	Oxford	1,864	420
Sussex	5,551	105	Somerset	1,548	169
Hampshire	3,134	56	Devon	1,135	36
Dorset	853	136	Cornwall	1,082	296
				18,090	1,545

As break crops in the south, there are two other newcomers worth mention—maize and oilseed rape. Although they will be more profitable at E.E.C. prices neither is likely to be as profitable as sugar beet on good soil.

An estimate has therefore been prepared on the same lines as for new growers in existing factory areas. The number of farms of each type in the South East and South West regions are shown in Table 3.6. The estimated percentage of acceptances and the acreage per farm are based partly on the percentages in other regions and partly on estimates of colleagues in the area concerned.

Table 3.6 Estimate of Additional Growers in Southern England

Farm Types	*No. of Farms*	*Assumptions*			*Estimated Sugar Beet (acres)*
		Percent Accepting	*Farms Accepting*	*Acres per Farm*	
General Cropping	1,034	40	414	30	12,420
Mostly Cereals	2,139	18	171	20	3,420
Mixed	4,168	10	417	20	8,340
General Horticulture	3,027	5	151	15	2,265
Mainly Dairy	6,359	2	127	15	1,905
Total	16,727	8	1,280	22	28,350

Counties: Berks., Bucks., Hants., Isle of Wight, Kent, Oxford, Surrey, Sussex, Cornwall, Devon, Dorset, Gloucs., Somerset, Wilts.

The estimate of 28,350 acres (say 50,000 tons sugar) is enough to justify a new factory. There are economies of scale and this size is somewhat below the optimum of about 45,000 acres. Transport from outlying counties would be expensive.

The south coast is not the only possible location. It might be possible to fit a new factory in one of the existing areas where there is a strong demand and existing factories are already quite large e.g. in Norfolk or Suffolk. Besides tapping new growers in an area known to be suitable for the crop, existing growers near by could save on transport costs by supplying the new factory.

The British Sugar Corporation might however prefer to enlarge existing factories on the grounds that this is cheaper per ton processed than a new factory. If, however, under E.E.C. rules, transport is paid by the factory, the savings in transport by opening a new factory would have to be set against the additional cost.

The Alternatives Available

It is suggested that the extra acreage obtainable from the three alternatives is as follows:—

1 From existing growers .. .. 108,000 acres
2 From new growers near existing factories .. .. 65,000 acres
3 From new growers with a new factory in Southern England .. 28,000 acres

As to production of sugar, the national average yield for the 5 years 1967/71 is 2·01 tons of white sugar per acre. There is no simple way of assessing the average yield to be expected from a new crop in a whole region with a wide diversity of conditions. It has therefore been assumed that the potential is the same as the existing regions, subject to the deductions given below. A reasonably conservative estimate would be (a) a reduction of 5 per cent in yield per acre for new acreage on existing farms on the assumption that the crop is extended to slightly less suitable soil; (b) a reduction of 10 per cent on new farms near existing factories on the assumption that some of these farms are less suitable and

the growers are less experienced; (c) a reduction of 10 per cent for new growers in a new factory area. This will allow for inexperience and errors in the choice of farms and farmers to grow the crop. On the other hand, the best land has not yet been pre-empted. On this basis, production might be:—

1 From existing growers:

108,000 acres × 1·90 tons per acre = 205,200 tons

2 From new growers near existing factories:

65,000 acres × 1·80 tons per acre = 117,000 tons

3 From new growers near a new factory:

28,000 acres × 1·80 tons per acre = 50,400 tons

Total	201,000 acres	372,600 tons

These totals should be compared with the Australian quota of 335,000 tons of raw or approximately 308,000 tons of white sugar which these new supplies would be expected to replace.

These three targets could not be attained with equal speed. Existing growers could expand their acreage quite quickly. Farmers would realise that if they did not take up offers of increased acreage, the opportunity might not come again. New growers in existing factory areas could be recruited fairly quickly but might require three or four years to attain full yields. They would, however, be surrounded by other experienced growers and would profit from their example.

The recruiting of growers for a new factory would be the most difficult of the three. It would be an entirely new and strange crop to most of the growers and five or six years might be required to attain either the acreage suggested or reasonable yields per acre. There are, of course, farmers in the area who grew sugar beet twenty years ago but techniques have changed greatly since then. Indeed, the yields obtained in the South at that time would be quite uneconomic now.

While these are no more than tentative estimates, there can be little doubt that an increase of 100,000 acres or even 200,000 acres of sugar could be attained without undue difficulty. A target of 400,000 tons would probably be feasible.

Before erecting a new factory, it would be advisable to interview a sample survey of farmers to test demand. It is suggested that time could be saved by concentrating on the farm types shown in this section to be the most likely to grow the crop. In an existing factory area, such a survey would not be difficult. Even farmers who had never grown the crop would be familiar with it. The majority of them would probably have quite definite opinions on whether or not they would like to grow the crop. It would be more difficult to get reliable answers in a new area. Many farmers would prefer to wait for a neighbour to try it first.

AN ECONOMIC APPRAISAL

It now remains to estimate the effect on the national economy of growing more sugar beet in this country. This is not necessarily the same as the effect on an individual firm such as the farmer or the British Sugar Corporation. To give an example, the subsidy on fertilisers is a receipt so far as the farmer is concerned. From the national point of view, however, it is a transfer payment which is omitted from the calculation. The appraisal given here is no more than tentative because very little information about inputs is published either by the British Sugar Corporation or by any of the other bodies that deal with sugar production on a national or international scale. The financial gains in favour of extending seem, however, to be large enough to cover by a substantial margin any likely error in the estimates made. The following are the assumptions made.

1 The Australian quota under the Commonwealth Sugar Agreement is for 335,000 tons of raw sugar which is purchased for £50 per ton. If this is given up when the Commonwealth Sugar Agreement expires, there are three alternatives sources of supply:—

a We can import supplies from the E.E.C. which has a surplus of white beet sugar. The price that we may have to pay is still uncertain but it is likely to be in the neighbourhood of £100 per ton. We are unlikely to be able to buy from the E.E.C. raw sugar for refining here. The European beet factories produce refined sugar and raw sugar imported from the French sugar islands already have a market and is less likely to come here.

b We can buy supplies on the world market. The E.E.C. levy on imports is likely, however, to bring the price at least up to the level of E.E.C. supplies.

c We can produce more sugar in this country.

As proposition (b) does not appear to offer any advantage over (a), it will be ignored. The project is thus to compare (a) with (c).

2 As already stated, it would probably be possible to grow an additional 200,000 acres of beet. The estimate that follows is for 100,000 acres and could be increased proportionately for a larger area. Increased tonnage would require more processing plant. It is assumed that a new factory costs £150 per ton capacity or, say, £15m. for one handling 100,000 tons. Extensions to existing factories should produce some economies of scale because some of the existing equipment, offices, access roads, etc. will suffice or at least need not be increased proportionately. Opportunities also arise as equipment is replaced to instal a larger size, thus providing additional capacity at a modest cost. A figure of £100 per ton capacity or £10m. for 100,000 tons is assumed making a total of £25m.

The whole of the extra beet could probably be grown by existing growers, most of whom have sufficient harvesters and drills. Assuming, however, that as many as half the growers are new, requiring specialised equipment at £30 per acre, 50,000 acres would require £1·5m. To this, might be added an allowance of £0·5m. for extra equipment for existing growers, making £2m. in all.

The cost of processing beet sugar in England has been assessed as follows:—

British Sugar Corporation, net sales[1] ..		£78·7m.
Less Profit	6·7	
„ Depreciation	2·1	
	——	8·8m.
		£69·9m.
Say		£70·0m.
Less Purchases of beet (approx.)	49·0	
„ Capital expenditure[2]	3·0	
	——	52·0
		£18·0m.[2]

With a throughput of 892,000 tons of sugar, this represents a cost of approximately £20 per ton.

It is assumed that processing in a new factory will cost £20 per ton. There should be some economies in expanding existing factories because many items—supervisory staff, office expenses, research, directors' fees, etc.—need not be increased in proportion to output. Detailed analysis to divide costs into fixed and variable items would be necessary to assess these items accurately. A provisional estimate of £15 per ton is assumed.

100,000 tons @ £15	£1·5m.
100,000 tons @ £20	£2·0m.
	£3·5m.

[1] Sugar Board. Report for year ending 31 December, 1971 (H.M.S.O.).

[2] These figures agree reasonably with the net output of £17m., Census of Production, 1968 (H.M.S.O.).

Additional costs for farmers can be estimated easily from the survey data assuming that (as most farmers stated) sugar beet would replace barley.

It is assumed that the farmer already has tractors and cultivating equipment which will work an extra 10 hours per acre. Farmers are unlikely to employ additional workers but some may require extra overtime or casual labour. No decrease in other agricultural output is assumed for the reasons given in Chapter 2.

Tractor fuel	£75,000
Upkeep of specialised equipment	370,000
Additional upkeep of tractors and other equipment	140,000
Fertilisers 17,500T @ £40	700,000
Labour	250,000
	£1,535,000

The annual costs are thus as follows:—

Processing factories	£3·5m.
Farmers	£1·5m.
	£5·0m.

Annual benefit is:—	
185,000 tons @ £100	£18·5m.

The new capacity, properly maintained, should last indefinitely. On the assumption that it might be obsolete or no longer required after 20 years, the project is given a life of 20 years with no scrap value.

Assuming that the new factory and extensions to existing factories take place over the first two years and that production is in full swing by the fifth year, the list of costs and benefits can be estimated as shown in Table 3.7.

Table 3.7 Net Cash Flow from Growing Additional 100,000 Acres Sugar Beet

		Expenditure		
£m.	*Benefits*	*Capital*	*Annual*	*Net Cash Flow*
Year 0	—	−12	—	−12
1	6	−10	−2	− 6
2	10	− 5	−4	+ 1
3	14	—	−5	+ 9
4	16	—	−5	+11
5 to 20	18·5	—	−5	+13·5

There is a deficit of £12m. at the beginning and of £6m. in the first year. This is followed by an increasing surplus as production reaches a maximum of £13·5m. in the fifth to the twentieth year.

Two standard criteria of investment are shown in Table 3.8. A reasonable assumption is that a project should show a return of not less than 10 per cent on the amount invested.

Table 3.8 I.R.R. and N.P.V. from an Additional 100,000 Acres Sugar Beet

£m.	Net Cash Flow	Discounted at 10%	Discounted at 39%
Year 0	−12	−12	−12
1	−6	−5·454	−4·317
2	+1	0·826	0·518
3	9	6·759	3·351
4	11	7·513	2·947
5 to 20	13·5	72·144	9·225
Net Present Value		69·788	−0·276

Column 2 shows that after allowing interest and writing off the investment, there is a surplus or Net Present Value of nearly £70m. A second criterion, much favoured by the World Bank, is the Internal Rate of Return (I.R.R.). This is the rate which equals benefits and costs. It will be seen from column 3 that the return on capital is 39 per cent—a very high rate.

One further point should be noted. This assessment assumes that the capital investment is written off in 20 years. The factories would no doubt have a value and still be in operation after that date. The estimate of benefits is therefore a conservative one.

BALANCE OF PAYMENTS

In the appraisal just made, the benefits obviously provide a large saving of imports. What of the costs? Apart from the raw materials for fertilisers and fuel oil, the direct import element in these costs is quite small. The effect on the balance of payments of setting up such a project does, however, go well beyond this point. Any expenditure means the diversion of resources from some other use including the production of goods for export. In a booming economy and indeed in a developing country where resources are tightly stretched, the cost of inputs used for a project might represent a loss of other goods that could be exported or could replace imports. Even on this conservative basis, it is obvious that the saving in imports of sugar far outweighs the cost of all resources used.

If the economy is not fully stretched and resources are underemployed, different considerations apply. If, for example, the fertiliser manufacturers are working below capacity, then the marginal cost of producing some more fertiliser might be very little more than the cost of imported raw materials. The same could apply to labour if the workers would otherwise be idle. In that case, the cost would be the difference between their wages and social security payments.

At present, there is some unemployment of men and manufacturing capacity in this country. It could, therefore, be argued that the net cost (or shadow price) of a number of the inputs required for expansion of the sugar industry could be valued at less than that stated in this appraisal. If so, the project would (to the nation as a whole) be more advantageous and give a higher return on the capital employed than that stated.

It would, however, be difficult to estimate such indirect effects without a detailed analysis of the inputs required. In any case, the amount of 'slack' in the economy might diminish substantially within the next year or two. Such a form of special pleading is however unnecessary because the project appears to provide an adequate return even under conditions of full employment.

AUSTRALIAN SUGAR

Another possibility if we did not join the E.E.C. or subsequently left it is that we should substitute home grown sugar for Australian sugar at the C.S.A. price. This project gives a return of 11 per cent on capital invested. It might thus be just worthwhile to substitute home grown sugar for Australian.

This does not mean the British sugar costs less to produce than Australian. On the contrary, Australian sugar costs per ton are reputedly amongst the lowest in the world. This fact is however irrelevant because the C.S.A. price is set high enough to provide a very reasonable margin of profit to Australian producers and at that price, British beet sugar is competitive. In fact, the advantage of changing from Australian to British sugar would be comparatively small. There would in theory be more advantage in changing from West Indian, Mauritian or Fijian sugar to British home supplies because the C.S.A. price for them is higher than for Australian. We are, however, most unlikely to wish to deprive developing Commonwealth countries of a market for their sugar.

These propositions are however of no more than academic interest. If we did not join the E.E.C., the Commonwealth Sugar Agreement would almost certainly be continued so long as Commonwealth countries wished it.

Assuming that we do join the Common Market, there is a different aspect worth comment. If under E.E.C. rules we cease to import sugar from Australia, this might effect our exports to that country. The point has been examined by Phillips and Ritson[1] who found significant correlations between the amount of imports and exports to countries that traded heavily with this country. They found, for example, a 'reciprocity coefficient' of 0·7 for trade with Australia and for sugar in particular of 0·5. This appears to mean that if we ceased to import £10m. of sugar from Australia, our exports to Australia would decline by £5m.

Some economists, however, are sceptical of this relationship. Indeed, if trade is relatively free between two countries, they fail to see what mechanism could relate the actions of importers and exporters who are usually different persons with entirely different interests. It is, however, possible if Commonwealth preferences disappear, that the Australians may tend in the long run to find new markets in Asia or America for produce that formerly came to this country. This may lead to other trade links for Australian imports. Such a reorientation of Australian trade may be regrettable but inevitable. Sugar exports to the U.K. which account for only 1 per cent of total Australian exports will however play only a minor part in this process.

[1] Phillips, S. and Ritson, C. Agricultural Expansion and the U.K. Balance of Payments. National Westminster Bank Review. February, 1970.

Summary

Chapter 1

1 A survey of sugar beet growers covering the 1970 harvest was carried out, based on a random sample of 104 growers, stratified in three size groups—1–20 acres, 20–50 acres and over 50 acres of sugar beet. The costs and returns are given in detail in Table 1.1. The large units had lower yields and lower gross margins per acre than the medium and small.

2 It was evident that farmers with small units spent on average almost the same amount on fertilisers, seeds and sprays as the medium and larger farmers and obtained the same yields as the medium and rather better yields than the large units. Their disadvantage is that the acreage is too small to justify the purchase of new harvesters and other equipment. They are thus more dependent on contractors, on buying second hand equipment, or on sharing equipment with neighbours.

3 Over the whole sample, the gross margin and net margin both depended heavily on yield per acre. There was no evidence that growers adopting labour saving devices such as drilling to a stand or using herbicides to eliminate weeds suffered any loss of yield.

Chapter 2

1 There is no reason to believe that sugar beet suffers from any fundamental cost disadvantage in comparison with sugar cane. As evidence, a comparison between England and Jamaica shows that the gap in costs per ton of sugar up to the factory gate has disappeared between 1954 and 1970. In processing and transport, sugar beet grown in this country has a natural advantage over imported cane sugar.

2 The economics of producing sugar beet have changed substantially in recent years. Man hours per acre have fallen by 85 per cent between 1943 and 1970 and the crop is now much less labour intensive. The yield of sugar per acre has in the same period increased by 50 per cent.

3 An expansion of sugar beet would benefit British agriculture in a number of ways:—

a Apart from potatoes and vegetables, it is one of the most profitable crops on the arable farm.

b The proportion of cereals has increased and is likely to increase further with higher E.E.C. prices, The practice of growing cereals after cereals on the same soil increases the risk of disease. Sugar beet would provide a break crop which is more profitable than alternatives such as field beans, oilseed rape or leys for livestock. The only alternatives as profitable as sugar beet are potatoes, for which the market is static or declining and vegetables for which opportunities are limited.

c Sugar beet is complementary to cereal crops. The traditional reason was that it was a cleaning crop. With the introduction of herbicides, this is a less vital factor but it is still an asset. A more important aspect is that sugar beet is complementary to cereals in the use of labour. The addition of sugar beet to a cereal growing farm can thus enable the farmer to produce a larger output with the same staff and furnish him with a larger farm income.

d An expansion of sugar beet might help to slow down the loss of farm workers to agriculture—a process which, if too rapid, could be damaging to the industry.

4 If more sugar beet is grown, it will displace other crops—principally barley. The loss of 100,000 acres among 5 million acres of barley is however negligible and could well be compensated by increased yields of cereal crops following sugar beet. In addition, the sugar beet pulp produced as a by product would produce nearly as much cattle food as the barley displaced. The extra sugar produced is thus likely to be a net increase in output.

5 If we join the E.E.C., the farmers' receipts seem likely to increase to some extent. The farmers' quota is likely to be on a tonnage not an acreage basis. The farmer would thus have a choice of growing

his quota intensively on a small acreage or less intensively on a larger acreage. This and the 35 per cent excess at a lower price will introduce more flexibility into farmers' plans. The factory, having contracted for a definite tonnage, will be able to plan the length of the processing season with more precision.

Chapter 3

1 If sugar production is expanded, additional acreage of beet can be obtained from three sources: (a) existing growers; (b) new growers in existing factory areas; (c) a new factory and new growers.

2 Two-thirds of the farmers interviewed would like to grow more sugar beet. If this random sample is accepted as representative, existing growers would be prepared to grow an extra 108,000 acres or 205,000 tons of sugar.

3 An attempt was made to estimate the potential demand from new growers in existing areas. This was prepared by identifying the types of farm at present growing the crop and estimating the proportion of those not growing the crop who were prevented by lack of a contract from doing so. The estimate was 65,000 acres or 117,000 tons of sugar.

4 A similar estimate was prepared for a new factory in the south of England. This amounted to 28,000 acres or 50,000 tons of sugar.

5 It would be advisable before erecting a new factory to test the demand in the area concerned. Time could be saved by concentrating on the farm types shown to be the most likely to adopt the crop.

6 These estimates total 370,000 tons of white sugar which is more than enough to replace the Australian C.S.A. quota of 308,000 tons (335,000 tons raw sugar).

These three alternative targets could not be attained with equal speed. Existing growers could expand their acreages quite quickly. New growers in existing areas could be recruited fairly quickly but would require three or four years to attain reasonable yields. Recruiting for a new factory in a new area would be the most difficult of the three.

7 An attempt has been made to assess in national terms the return on the capital required for 100,000 acres or 185,000 tons of white sugar. It is assumed that the alternative to growing more sugar here is to import it at £100 per ton. On a sum of £25m. for factory erection and £2m. for farmers' equipment, the Net Present Value of the investment over 20 years is £70m. The Internal Rate of Return is 39 per cent. These are presented as no more than tentative estimates based on this survey and such published material as is available. The margin of advantage seems however to be large enough to allow for contingencies.

8 This result depends on the price that would have to be paid in the E.E.C. for imported sugar. The price assumed is £100 per ton. With a price as low as £50 per ton, the return on investment on the assumptions made would still exceed 10 per cent.

Appendix

Costs Used in the Survey

Labour was charged on the basis of the annual wage plus National Insurance payments. The minimum wage rate was charged at 33p per hour (6/8½). Other rates were calculated in the same way to arrive at rates applicable to each farm.

Tractors were charged at the following hourly rates which allow for depreciation, fuel and oil and repairs:—

a Wheeled tractors (2 wheel drive)

1	Less than 46 b.h.p.	£0·3 per hr.
2	46·5–58·5 b.h.p.	£0·35 per hr.
3	Greater than 58·5 b.h.p.	£0·45 per hr.

b Crawler and powerful 4 wheel drive were all charged at £0·9 per hr.

Non Specialised Machinery was charged at standard rates as follows:—

	Per Acre
Ploughs	£0·3
	Per Hour
Cultivators	£0·1
F.Y.M. Spreader ..	£0·1
Harrows	£0·3
Fertiliser spinners ..	£0·3
Sprayers	£0·45

Specialised Machines were costed individually using 20 per cent depreciation rates and including 1970 repair bills. Where necessary, the costs were allocated according to total acreage covered in the year.

Seed, Fertilisers and Sprays were charged at cost. (Net of subsidy.)

Farmyard Manure was charged at £0·5 per ton. This allowed for an expected nutrient value of £1 per ton to be spread over 2 years. The cost of application was also spread over 2 years.

Lime Costs. Liming materials were recorded at cost but only one-third was charged to the sugar beet crop.

Rent was the actual amount paid per acre, or in the case of owner-occupiers, an estimate of local market value. Drainage rate was added where paid.

General Farm Overheads were allowed at 15 per cent of total allocated costs.

Value of Sugar Beet Tops was excluded from the output figures used in producing statistical data, but where comments are made they have been valued at £4 per acre. This assumes a utilisation of 1 ton of tops per acre.

Costs per Acre (Overall Average)

			S.E.
Number of farms		104	
Yield per acre (tons)		13·8	
Sugar content		17·1%	
Gross Output		£107·6	2·7
Variable Costs:			
Seed	4·1		0·1
Fertiliser	12·7		0·3
Sprays	4·0		0·2
	——	20·8	
Gross Margin A		86·8	
Contract haulage	7·6		0·6
Contract other	2·2		0·4
Casual labour	2·5		0·4
Regular labour bonus	1·0		0·2
Miscellaneous	0·6		0·1
	——	13·9	
Gross Margin B		72·9	2·4
Fixed Costs:			
Regular labour	14·1		0·7
Haulage (own lorries)	1·2		0·2
S.B. machinery	3·7		0·3
Share of other implements	1·4		0·1
Tractors	7·1		0·3
Machinery (Total)	13·4		
FYM Line B/Slag, etc.	0·7		0·2
Rent and rates	9·3		0·4
Other overheads	10·9		0·2
Total fixed costs		48·3	1·2
NET MARGIN		24·6	2·4
Specialised Machinery Capital per acre		£11·8	1·4

Note: Discrepancies in sub totals due to rounding errors.

Commonwealth Sugar Agreement

The quantities of sugar that the British Government has agreed to buy at negotiated prices are:—

Long tons	*Raw*	*Refined (equivalent)*
Australia	335,000	308,200
British Honduras	20,500	18,860
East Africa	7,000	6,440
Fiji	140,000	128,800
India	25,000	23,000
Mauritius	380,000	349,600
Swaziland	85,000	78,200
West Indies and Guyana	725,000	667,000
	1,717,500	1,580,100

The price for 1972, 1973 and 1974 is £50 per ton for Australia plus a special payment for less developed countries varying from £7 (when the World Price exceeds £41) up to £11 (World Price below £33). (The price for 1966/71 was £43·50 plus £1·50 to £4 per ton.)

U.K. Trade in Sugar

000 *tons (refined equivalent)*	1965/68	1969	1970
Imported	1,902	1,891	1,665
Produced in U.K.	866	911	838
Exported	280	200	186
Used in U.K.	2,414	2,440	2,448

Value of imports (1970)	£95·0m.
Value of exports (1970)	8·8m.
Deficit	£86·2m.

Annual Abstract of Statistics, H.M.S.O.

Source of Imports. Average (1965/68) 000 tons (refined equivalent)

Commonwealth		*Foreign*	
Australia	369	South Africa	64
Fiji	132	Brazil	56
Mauritius	389	Cuba	59
West Indies	599	Poland	23
Other	153	Other	58
	1,642		260

Plantation Crops. Commonwealth Secretariat. (West Indies includes Guyana and British Honduras.)

World Price of Sugar

(London daily price per ton raw c.i.f.)

	Average	*Highest*	*Lowest*		*Average*	*Highest*	*Lowest*
1962	£26	£40	£20	1967	£19	£32	£12
1963	72	105	40	1968	22	31	16
1964	51	94	25	1969	34	39	27
1965	22	27	18	1970	40	45	30
1966	18	24	13	1971	46	70	40

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