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*Cereal foods*

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UNIVERSITY OF NOTTINGHAM

Department of Agriculture and Horticulture



**THE USE OF FIXED RESOURCES  
IN CEREAL PRODUCTION**

H. W. T. Kerr

Agricultural Enterprise Studies in England and Wales Economic Report No. 59

December 1977

UNIVERSITY OF NOTTINGHAM

Department of Agriculture and Horticulture

**THE USE OF FIXED RESOURCES  
IN CEREAL PRODUCTION**

A Study of 36 Cereal Producers  
in the East Midlands

H. W. T. Kerr

Price £1.00

December 1977

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## AGRICULTURAL ENTERPRISE STUDIES IN ENGLAND AND WALES

University departments of Agricultural Economics in England and Wales have for many years undertaken economic studies of crop and livestock enterprises, receiving financial and technical support from the Ministry of Agriculture, Fisheries and Food.

The departments in different regions of the country conduct joint studies of those enterprises in which they have a particular interest. This community of interest is recognised by issuing enterprise studies reports prepared and published by individual departments in a common series entitled "Agricultural Enterprise Studies in England and Wales".

Titles of recent publications in this series and the addresses of the University departments are given at the end of the report.

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# 1. INTRODUCTION

## 1.1 The Aim of the Study

There is a considerable amount of up-to-date information available relating to the output and variable costs of cereal production; even if it does not necessarily originate from representative farm samples, but data regarding the use of fixed resources is much scarcer. The first objective of this study was to supplement in the East Midland Region the data collected in the National Cereal Survey carried out in 1971 and 1972 and up-dated in 1975<sup>1</sup>.

Previous studies<sup>2</sup> have found little evidence of any clear relationship between output or the variable resource element of cereal production and size of operation. If advantages of size do occur it has been suggested that they may be found in the use of fixed resources. The second aim was to attempt to examine this proposition in greater depth.

## 1.2 The Sample

The sample used was obtained from a random list divided into four size groups relating to the total area of cereals grown as shown in Table 1. The size groups corresponded to those used in the National Cereals Survey<sup>3</sup> but omitting the smallest group of 10 to 49 acres and combining those of 200 to 299 acres and 300 to 499 acres into one. The division between the size groups were set at points which were thought to have some relevance to the use of fixed resources in growing the crop.

The results have been analysed in these four size groups and a distinction has been made between winter and spring cereals where appropriate, but not between the different cereals. The list was drawn up before the change to metrication and the grouping was made in imperial units. The size groupings are given in acres and hectares in Table 1, and in order to avoid confusion they are referred to subsequently as Groups 1, 2, 3 and 4. The conversion to hectares has been rounded off and is not exact, but every farm in the sample still fell within the boundaries of the same size group.

TABLE 1 *SIZE GROUPINGS BY AREA OF CEREALS GROWN*

Size Group	Range	
	Acres	Hectares
1	50 – 99½	20.0 to 39.9
2	100 – 199½	40.0 to 79.9
3	200 – 499½	80.0 to 199.9
4	500 and over	200 and over

<sup>1</sup> Davidson, J. G. "Cereal Production in England and Wales 1971-1975". Agricultural Enterprise Studies in England and Wales, Economic Report No. 47. University of Cambridge, Dept. of Land Economy. 1977.

<sup>2</sup> Jackson, B. G., and Sturrock, F. G. "The National Wheat Survey, 1964". University of Cambridge, Dept. of Land Economy, December 1969.

<sup>3</sup> Jackson, B. G. and Sturrock, F. G. op. cit.

The collection of data was carried out during the winter of 1975-76. Farmers were asked to give information regarding the "normal" situation on their farms, so the results do not reflect the special conditions encountered in 1975.

Information was collected about all machinery used on the cereal crop. An assessment of the proportionate use of general equipment was obtained and the figures relate to use on the cereal crop only.

### 1.3 Distribution of the Sample

The geographical distribution of the thirty-six farms in the sample is given in Table 2. "Lincolnshire" includes South Humberside but excludes the old Holland division.

The distribution of the farms in the size groups used in the analysis is shown in Table 3.

TABLE 2 GEOGRAPHICAL DISTRIBUTION

County	No. of Farms	Total Area	Area in Cereals
		hectares	hectares
Derbyshire	2	128.7	80.9
Leicestershire	5	398.2	169.2
Nottinghamshire	7	1358.2	786.3
Lincolnshire <sup>(1)</sup>	13	3589.6	1877.4
Northamptonshire	8	1785.1	985.8
Oxfordshire	1	186.6	149.9
Total	36	7446.4	4049.5

(1) Including South Humberside, but excluding the old division of Lincs. (Holland).

TABLE 3 SIZE DISTRIBUTION

Size Group	No. of Farms
1	11
2	8
3	13
4	4
Total	36



## 1.4 The Pattern of Farming

The proportion of the total farm area in the main crops is shown in Table 4. The proportion of the farm in arable crops is less in the two smaller groups than in the two larger ones. The proportion of the cereal area in winter crops increases with the size of the farm and is probably associated with the greater proportion of arable break crops grown and the higher ratio of temporary to permanent pasture. Five farms carried no livestock enterprises but only two farms had no grass at all, the others maintaining very small areas of permanent pasture. One farm carried a pig enterprise only and another had poultry only. Of those with grazing livestock enterprises, six had dairy herds (dairy cows with followers), five with some beef cattle as well, and the rest carried beef cattle and/or sheep, several with additional pig enterprises.

TABLE 4

### GENERAL CROPPING

Proportion of Total Area

Cropping	Size Group				All Farms
	1	2	3	4	
	%	%	%	%	%
Winter Cereals	15.30	15.86	28.68	33.22	27.44
Spring Cereals	27.52	33.81	31.06	23.51	28.15
Sugar Beet	3.39	2.96	8.09	4.76	5.71
Potatoes	1.57	1.25	2.81	4.08	2.97
Field Beans	1.30	—	1.30	0.66	0.90
Other Cash Crops	3.45	—	7.43	7.12	6.00
Other Forage Crops	1.41	1.39	0.34	2.17	1.27
Fallow	1.83	—	2.07	2.80	2.07
Total Arable	55.77	55.27	81.78	78.32	74.51
Temporary Grass	16.55	16.93	9.73	14.10	12.99
Permanent Grass	27.68	27.80	8.49	7.58	12.50
Total Grass	44.23	44.73	18.22	21.68	25.49
Total Crops & Grass	100.00	100.00	100.00	100.00	100.00

TABLE 5 TOTAL LABOUR AND MACHINERY REQUIREMENTS FOR MAIN OPERATIONS  
(INCLUDING CONTRACT)

		SPRING					WINTER				
		Size Group				All Farms	Size Group				All Farms
		1	2	3	4		1	2	3	4	
Total Area of Cereals	Hectares	213.3	275.6	891.5	649.9	2030.3	118.6	159.0	823.4	918.2	2019.2
<b>Operation</b>		<b>per hectare grown</b>					<b>per hectare grown</b>				
Stubble Cultivation and Ploughing	Man Hours	6.1	4.9	2.8	3.4	3.6	4.3	4.9	2.7	3.7	3.4
	Tractor Hours	6.1	4.9	2.8	3.4	3.6	4.3	4.9	2.7	3.7	3.4
Working Down and Drilling	Man Hours	3.9	3.4	3.5	2.4	3.2	3.5	3.7	3.4	3.3	3.4
	Tractor Hours	3.9	3.4	3.3	2.0	3.0	3.5	3.7	3.4	2.9	3.2
Post-Drilling Operations	Man Hours	1.4	1.4	1.3	1.0	1.2	2.2	1.9	1.4	1.9	1.8
	Tractor Hours	1.4	1.4	1.3	1.0	1.2	2.2	1.9	1.4	1.7	1.7
Harvesting	Man Hours	3.1	3.4	2.7	2.7	2.9	3.7	3.6	2.6	2.2	2.5
	Tractor Hours	1.7	1.9	1.4	0.2	1.1	2.2	2.1	1.3	0.6	1.1
	Combine Hours	1.2	1.5	1.1	1.3	1.2	1.5	1.5	1.1	1.0	1.1
	Lorry Hours	0.3	—	0.3	1.3	0.5	—	—	0.2	0.5	0.3
Total, Up to and including Harvest	Man Hours	14.5	13.1	10.3	9.5	10.9	13.7	14.1	10.1	11.1	11.1
	Tractor Hours	13.1	11.6	8.8	6.6	8.9	12.2	12.6	8.8	8.9	9.4
	Combine Hours	1.2	1.5	1.1	1.3	1.2	1.5	1.5	1.1	1.0	1.1
	Lorry Hours	0.3	—	0.3	1.3	0.5	—	—	0.2	0.5	0.3
Post Harvest	Man Hours	3.2	2.7	3.0	4.7	3.6	5.4	2.6	2.7	2.3	2.7
	Tractor Hours	2.5	2.1	2.7	3.5	2.9	4.3	2.3	2.5	2.0	2.3

## 2. LABOUR AND MACHINERY REQUIREMENTS

### 2.1 Total Labour and Machinery Requirements

The total labour and machinery requirements for the main operations on both winter and spring crops are given in Table 5 and include all labour and machinery supplied on contract.

Little difference is shown in the requirement for winter and spring crops, but there is a clear difference between the requirements for the larger and the smaller areas.

### 2.2 Requirements for General Cultivations

In general, the traditional operations of ploughing and cultivating were carried out. Nobody direct-drilled but two farmers used a bipyridyl weedkiller, one following with normal cultivations without ploughing, whereas the other followed with chisel ploughing. Another cultivated the winter crops only without ploughing or the application of weedkiller. Four farmers used chisel ploughs only and another two chisel ploughed first and then followed with conventional ploughs. An attempt was made to assess the influence of soil type on the cultivations carried out but many of the farms lay on more than one type and it was impossible to identify them precisely enough in a study of this kind.

### 2.3 The Use of Tractors

The proportion of the total tractor time supplied by different types of tractors: small (up to 50 h.p.); medium (50 to 80 h.p.); and large (over 80 h.p.): is shown in Table 6. No distinction is made between wheeled and crawler tractors. The use of lorries is included in the table since they were substituted for tractors and trailers for leading corn, and contract tractors are also shown separately since no information was available about their size.

TABLE 6 *SIZE OF TRACTOR EMPLOYED*  
*Hours employed as a proportion of Total Requirements*  
*Excluding Straw Saving Operations*

Size Group	Crop	Under 50 h.p.	50-80 h.p.	Over 80 h.p.	Lorries	Contract Tractors	Total
1	Winter	21.41	66.71	7.11	—	4.77	100.00
	Spring	14.64	74.16	3.40	2.11	5.69	100.00
2	Winter	3.99	89.08	5.24	—	1.69	100.00
	Spring	2.75	93.16	3.12	—	0.97	100.00
3	Winter	6.72	77.34	12.17	1.88	1.89	100.00
	Spring	5.88	77.11	14.07	2.94	—	100.00
4	Winter	4.21	46.10	42.94	5.87	0.88	100.00
	Spring	4.43	26.42	53.30	15.85	—	100.00

per cent

Most of the work was done by medium-sized tractors of between 50 and 80 h.p. More use was made of larger tractors on the bigger areas, especially on spring crops, whereas small tractors were employed more frequently on areas of less than 40 hectares (100 acres) than in the other size groups. Of the 115 tractors used, 44 were models of one manufacturer and 22 those of another.

#### **2.4 The Use of Combine Harvesters**

Twenty-nine of the thirty-six farmers in the survey owned their own combines, the other seven employing contractors. The area harvested by contractor represented just under 6 per cent of the total area of cereals grown and all farmers employing a contractor grew less than 40 hectares (100 acres), with the exception of one growing 61 hectares (150 acres). The main physical information relating to the combine harvesters owned by the farmers in the sample is given in Table 7.

Only one combine was used on farms growing up to 200 hectares (500 acres), whereas two or more combines were used on each of the farms with more than 200 hectares. This would suggest that it is necessary to consider using two combines at around 200 hectares of cereals grown. The farmer using only two combines for 494 hectares (1220 acres) would appear to be operating at the extreme limit and would have to be prepared to bring in a contractor if necessary. The average area harvested per combine in the two larger size groups was considerably less than 200 hectares, but clearly the machines were not being fully utilised at the lower end of the area ranges of these groups nor in the two smaller size groups. In fact, the combine cutting the biggest area was doing ten times more work than the one operating on the smallest area. However, almost all the combines used in the two smaller groups were older machines with 3.0 m to 3.7 m (10 ft to 12 ft) cuts and most of them were purchased second-hand. The oldest combine had worked twelve seasons and another had operated for eleven (up to and including the 1975 harvest). Newer 4.3 m (14 ft) cut machines were generally used on the bigger areas, but second-hand machines were also found on two farms at the lower end of Group 3, and again at the bottom of Group 4 where two combines were needed.

TABLE 7 PHYSICAL DETAILS OF FARMER-OWNED COMBINE HARVESTERS

Size Group	Area of All Cereals Grown	No. of Combines	Area harvested Per Combine	Year Purchased
	<i>Hectares</i>		<i>Hectares</i>	
1	24.7	1	24.7	1965
	31.2	1	31.2	1971 S/H
	31.2	1	31.2	1974 S/H
	34.4	1	34.4	1970 S/H
	37.2	1	37.2	1974 S/H
	<i>Average per Combine 31.7 hectares</i>			
2	40.5	1	40.5	1972 S/H
	40.5	1	40.5	1972
	40.9	1	40.9	1974 S/H
	46.5	1	46.5	1970 S/H
	49.0	1	49.0	1964
	76.9	1	76.9	1975 S/H
	79.7	1	79.7	1975 S/H
	<i>Average per Combine 53.4 hectares</i>			
3	86.2	1	86.2	1975 S/H
	92.3	1	92.3	1965
	93.1	1	93.1	1974 S/H
	111.3	1	111.3	1970
	114.5	1	114.5	1968
	114.9	1	114.9	1973
	121.0	1	121.0	1969
	125.9	1	125.9	1974
	129.5	1	129.5	1974
	149.9	1	149.9	1974
	186.6	1	186.6	1970
	192.2	1	192.2	1973
197.5	1	197.5	1975	
	<i>Average per Combine 131.9 hectares</i>			
4	242.0	2	121.0	1973 S/H
				1970 S/H
	297.5	2	148.7	1972
				1971 S/H
			1974	
493.7	2	246.9	1975	
535.0	4	133.8	1972 1975	
			1974 1975	
	<i>Average per Combine 156.8 hectares</i>			

S/H = Second-hand.

## 2.5 The Use of Drills

The main physical details of the drills used are shown in Table 8.

Only two of the thirty-six farmers hired drills, and the rest owned their own. Fewer drills than combines were purchased second-hand but these were not confined to the smaller areas. However, older machines were used on the smaller areas and newer machines on the larger, and on average drills purchased new had operated for 7 seasons (up to and including the 1975 harvest). Thirty-four out of the 40 machines used were combine-drills, although two farmers used them to drill winter wheat without fertiliser. Two of the six grain drills used were narrow-row. As with combine harvesters only one drill was used per farm in Groups 1, 2 and 3. Except for one farmer drilling 297 hectares (735 acres) with a grain drill, the others in Group 4 used more than

one drill, and it would again appear that the limit for one drill is somewhere around a total of 200 hectares (500 acres) of cereals. The drill covering the largest area was doing nearly fifteen times more work than the one operating on the smallest area.

TABLE 8 PHYSICAL DETAILS OF DRILLS

Size Group	Area of all cereals grown	Number of Drills	Type of Drill	Year of purchase	
1	<i>hectares</i>				
	20.2	1	Combine	1975 S/H	
	24.7	1	Combine	1968	
	26.3	1	Combine	1956	
	26.7	1	Combine	1960	
	29.1	—	Combine (Hired)	—	
	31.2	1	Grain	1975	
	31.2	1	Grain	1975 S/H	
	34.4	1	Combine	1964	
	34.4	1	Combine	1969	
	36.4	1	Combine	1969 S/H	
	37.2	1	Combine	1963	
	<i>Average per Drill 30.3 hectares</i>				
	2	40.5	1	Grain	1969
40.5		1	Combine	1963	
44.9		—	Combine (Hired)	—	
49.0		1	Combine	1968	
58.3		1	Combine	1965	
60.7		1	Combine	1968	
76.9		1	Combine	1974	
79.7		1	Combine	1972	
<i>Average per Drill 57.9 hectares</i>					
3	86.2	1	Combine	1973	
	92.3	1	Combine	1976	
	93.1	1	Combine	1975	
	111.3	1	Combine	1972 S/H	
	114.5	1	Combine	1969	
	114.9	1	Combine	1972	
	121.0	1	Combine	1975	
	125.9	1	Grain (Narrow-row)	1970 S/H	
	129.5	1	Combine	1976	
	149.9	1	Combine	1969	
	151.8	1	Combine	1972	
	186.6	1	Combine	1966	
	197.5	1	Combine	1975	
<i>Average per Drill 128.8 hectares</i>					
4	242.0	2	1 Combine Grain (Narrow-row)	1966 1973 S/H	
	297.5	1	Grain	1974	
	493.7	2	2 Combines	1975 1973	
	535.0	3	3 Combines	1964 1973 1974	
	<i>Average per Drill 196.0 hectares</i>				
			Area per drill		
			121.0		
			297.5		
			246.8		
			178.3		

## 2.6 Straw Saving Operations

Conventional balers were used on all the farms saving straw and there was no example of a large bale machine. The straw on a little over half the area of winter crops grown and on more than three-quarters of the area of spring crops was saved as shown in Table 9. The labour and machinery requirements are also shown in Table 9 expressed per hectare saved.

TABLE 9 LABOUR AND TRACTOR REQUIREMENTS FOR SAVING STRAW

	SPRING					WINTER				
	Size Group				All Farms	Size Group				All Farms
	1	2	3	4		1	2	3	4	
Area Saved ha	213.3	228.7	596.5	649.9	1688.4	114.5	119.6	552.8	312.6	1099.5
Proportion of area grown %	100	83.0	66.9	100	83.2	96.5	75.2	67.1	34.4	54.5
	per hectare saved					per hectare saved				
Man Hrs	3.2	3.3	4.5	4.7	4.3	5.6	3.4	4.0	6.7	4.9
Tractor Hrs	2.5	2.5	4.0	3.6	3.5	4.4	3.0	3.7	5.8	4.3

## 2.7 Drying and Storage Facilities

Details of the drying and storage facilities used are given in Table 10.

Three farmers with 40 hectares (100 acres) of cereals or less had no storage and sold all their corn off the combine. The most common method of both drying and storing was the on-the-floor system, often supported on the larger farms by other systems. In Group 4, three farmers used continuous flow dryers as well as on-the-floor, and the fourth dried by continuous flow machine only storing on the floor.

An average of just under 5 tonnes of storage space was provided on all farms per hectare of corn grown. Farms in Group 1 and particularly those in Group 4 provided more facilities than those in Groups 2 and 3.

TABLE 10 PHYSICAL DETAILS OF STORAGE AND DRYING FACILITIES

Size Group	Storage Capacity				
	On-Floor	Indoor Bins	Outdoor Bins	Total	Average per area grown <sup>(1)</sup>
	tonnes	tonnes	tonnes	tonnes	tonnes/ha
1	873.8	81.3	381.0	1336.1	5.0
2	891.0	727.5	—	1618.5	4.1
3	4013.5	2021.9	955.2	6990.6	4.1
4	8128.9	325.2	579.1	9033.2	5.8
All Farms	13907.2	3155.9	1915.3	18978.4	4.7

(1) By those with storage.

Group 1 including area of two with no storage — average 4.0 t

Group 2 including area of one with no storage — average 3.7 t

**Drying Facilities**

Group 1	3	None
	4	On-Floor
	2	In Bin
	1	Batch
	1	Continuous Flow
Group 2	1	None
	3	On-Floor
	3	In-Bin
Group 3	1	On-Floor and In-Bin
	3	On-Floor
	2	In-Bin
	2	Continuous Flow
	5	On-Floor and In-Bin
Group 4	1	On-Floor and Continuous Flow
	1	Continuous Flow
	3	On-Floor and Continuous Flow



### 3. INVESTMENT IN FIXED RESOURCES

#### 3.1 Total Investment in Equipment

A summary of the total investment in equipment is given in Table 11. The investment, split between that for grain production and that for straw saving is given in Table 12. The figures for the share of general equipment are based on an estimate of their proportionate use for cereal production. The whole inventory has been assessed at its current value; that is, the written down value of each items' 1976 purchase price. In the case of second-hand machinery and drying and storage facilities the original purchase price has been adjusted to the 1976 price using the M.A.F.F. indexes given in Appendix 1, Table 4. The diminishing balance method was used for writing-down the value of all items of equipment except storage and drying facilities for which the straight-line method was used over a period of ten years for the fixed equipment element and fifteen years for buildings. Tractors have been excluded because insufficient information was available to be able to make a reliable assessment of their proportionate use in cereal production.

TABLE 11 TOTAL INVESTMENT IN EQUIPMENT (other than tractors)  
AT CURRENT VALUE AT 1976 PRICES

£ per hectare grown

	Size Group				All Farms
	1	2	3	4	
Specific Equipment:					
Combines and Drills	19.03	44.66	47.07	50.14	45.69
Drying and Storage Facilities	24.78	21.99	35.54	27.55	30.10
Sub-total	43.81	66.65	82.61	77.69	75.79
Share of General Equipment (other than tractors)	52.51	40.25	26.17	23.20	28.69
Total Investment	96.32	106.90	108.78	100.89	104.48

TABLE 12

**INVESTMENT IN GRAIN PRODUCTION AND STRAW SAVING EQUIPMENT**  
(other than tractors)

£ per hectare grown

	Size Group				All Farms
	1	2	3	4	
Grain Production	86.13	99.82	104.78	96.43	99.47
Straw Saving	10.19	7.08	4.00	4.46	5.01

Note: Investment in Straw-Saving Equipment per hectare is shown in Appendix 1, Table 1.

**3.2 Investment in Machinery**

Details of investment in different classes of machinery used are given in Table 13. The same method was employed for arriving at the current value of the inventory as that used for Table 11.

TABLE 13

**INVESTMENT IN MACHINERY (other than tractors)**

£ per hectare grown

Type of Machine	Size Group				All Farms
	1	2	3	4	
Drills	9.14	10.33	7.71	6.18	7.51
Combines	9.88	34.32	39.36	43.96	38.19
Lorries	—	—	—	4.77	1.85
Cultivating Machinery	19.67	22.31	13.15	9.46	13.24
Sprayers	1.31	2.40	0.52	0.20	0.65
Straw Saving Machinery	10.19	7.08	4.00	4.46	5.01
Other Machinery	21.34	8.46	8.50	4.31	7.93
All Machinery (other than tractors)	71.53	84.90	73.24	73.34	74.38

### 3.3 Investment in Drying and Storage Facilities

Obtaining information about investment in drying and storage presented some difficulties. Particularly with on-the-floor systems it is impossible to separate the storage element from the building. Furthermore, whilst owner-occupiers erect their own buildings, landlords usually provide buildings for their tenants, but the tenant by no means always knows the original cost. The cost of new buildings erected during the tenancy is reflected in an increase in rent, but even when such an increase is made immediately after the erection of a building, the whole rise may not be directly due to it. A number of farmers also were able to make use of existing buildings and therefore only incurred the cost of adaptation. These figures therefore relate to the actual expenditure made by the farmers themselves whether they were tenants or owner-occupiers.

These results show that the reason why the level of investment on farms in Group 1 is no greater than that in the larger size groups is almost entirely due to the low level of investment in combines. The figures are related to the total area of cereals grown in each group and, therefore, encompass the effect of using contract machinery. Also, as shown in Chapter 2, growers in Group 1 purchased a high proportion of second-hand machines and kept them working for more seasons. The effect of these two factors is demonstrated in Table 14 by valuing the inventory at the current (1976) prices of new machines and comparing that with the current values used in Table 13.

TABLE 14 *TOTAL INVESTMENT IN MACHINERY (other than tractors)  
AT REPLACEMENT COST AND CURRENT VALUE AT 1976 PRICES*

£ per hectare grown

Size Group	Replacement Cost All New	Current Value
1	367.51	71.53
2	292.74	84.90
3	157.25	73.24
4	141.42	73.34
All Farms	183.05	74.38

#### 4. THE COST OF FIXED RESOURCES

An estimation of the total cost of the fixed resources used for growing cereals on the farms in the sample is given in Table 15. Further details of the fixed costs attributed to straw-saving operations are shown in Appendix 1, Table 2. These figures are based on data obtained from the study and various assumptions shown in the notes to the table. The labour and tractor time used and shown in the footnote excludes that provided by contractors, whereas in Table 5 shown earlier, contractors' time was included. Tractors have been charged on the usual standard charge basis, the calculations for which are shown in the Appendix 1, Table 3. These do not allow for any variation in the level of investment in tractors between the different size groups. For repairs<sup>4</sup> and rent, where farmers' own estimates relating to the 1975 crop have been used, a 20 per cent addition has been made to bring them up to 1976 levels. Similarly the figures used for general overhead costs, taken from the 1975-76 Farm Management Survey, have been increased by 20 per cent. Depreciation of equipment was calculated at 1976 prices using the diminishing balance current cost accounting method, i.e. machines were valued at their 1976 cost price and depreciated by the diminishing balance method over the number of years for which they had been held.<sup>5</sup> A comparison between this method and the usual method based on historic cost is shown in the Appendix 1, Table 5 and indicates that current cost depreciation is between three and four times greater than the historic cost depreciation. No specific charge has been included for the depreciation and repairs of buildings and fixed equipment because this is allowed for in the rent and general overhead costs given. Although a specific cost has been included in fuel for oil used for drying, electricity charges<sup>6</sup> have been excluded because they are covered by the general overhead figure taken from the Farm Management Survey. For the same reason tractor and combine taxes and insurances have not been included specifically. Contractors charges shown at the bottom of the table have been included in the total figures because, although they are classed as "variable costs" in the gross margin concept, they, in fact, relate to resources used as a substitute for fixed resources of the farm. When this is done the results do appear to indicate advantages in increasing size of operation.

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<sup>4</sup> Farmers own estimates of repair costs used in these figures seem low especially in relation to estimates often made by taking a percentage of the initial purchase price of a machine.

<sup>5</sup> No allowance has been made for backlog.

<sup>6</sup> Generally estimated to be 50p per tonne dried but dropping as low as 25p per tonne in one instance.

TABLE 15 ESTIMATE OF TOTAL FIXED COSTS OF GROWING CEREALS  
AT 1976 PRICES

£ per hectare grown

	Size Group				All Farms
	1	2	3	4	
Labour <sup>(1)</sup>	18.36	17.57	13.89	15.00	15.07
Allowances for Labour Overheads <sup>(2)</sup>	5.51	5.26	4.18	4.50	4.52
Tractors <sup>(3)</sup>	21.13	20.34	16.93	20.41	18.93
Allowance for Tractor Overheads <sup>(4)</sup>	3.16	3.04	2.54	3.06	2.84
Other Machinery:					
Depreciation <sup>(5)</sup>	30.00	36.00	25.10	24.29	26.37
Repairs <sup>(6)</sup>	4.18	3.83	2.87	2.99	3.21
Fuel <sup>(7)</sup>	1.26	1.85	2.10	4.77	3.04
General Overheads <sup>(8)</sup>	20.06	20.56	15.02	15.02	16.04
Rent <sup>(9)</sup>	42.60	31.93	41.24	40.30	39.93
Total excluding contract charges	146.26	140.38	123.87	130.34	129.95
Contract charges <sup>(10)</sup>	17.05	3.39	3.48	0.17	3.31
Total including contract charges	163.31	143.77	127.35	130.51	133.26

(1) Charged at £1.09 per hour (M.A.F.F. Wages Enquiry Average for tractor drivers, January to December 1976). Casual labour included but Contract excluded.

Size Group	1	2	3	4	All
Hours per hectare	16.85	16.11	12.75	13.76	13.84

(2) Charged at 30 per cent of direct labour cost.

(3) Charged at:

Up to 50 h.p.	£1.10 per hour;
50-80 h.p.	£1.42 per hour;
over 80 h.p.	£2.77 per hour.

For details of calculation see Appendix 1, Table 3.  
Contract excluded

Size Group	1	2	3	4	All
Hours per hectare	14.95	13.99	11.07	10.63	11.51

(4) Charged at 15 per cent of direct cost.

(5) Current Cost Diminishing Balance (1976 prices). For rates used see Appendix 2(i)(a).

(6) Repairs estimated by farmers (1975 plus 20 per cent) including Fixed Equipment.

(7) Combines at 22.47 litres per hectare (2 gals. per acre) harvested by own combines  
Lorries at 4.55 litres (1 gal) per hour  
Drying at 13.64 litres per tonne (3 gals. per ton) dried  
Electricity for drying allowed for in General Overheads.

Charged at  
6.16p per litre  
(28p per  
gallon)

(8) Maintenance and Miscellaneous for "Arable - Mainly Cereal" farms, Farming in the East Midlands 1975-76, plus 20 per cent. Allows for vehicle tax, insurance and electricity for drying.

(9) Rent and Rental Value reported by farmers in sample plus 20 per cent.

(10) Rates shown in Appendix 2(ii).

## 5. THE INFLUENCE OF SIZE OF OPERATION

In order to examine further whether there are any advantages arising from increasing the size of operation, analyses<sup>7</sup> were carried out on the relationships between the area of cereal grown and the labour and machinery requirements; the level of investment in combines, drills, general machinery and drying and storage facilities; and fixed costs. Straw-saving operations were excluded because of the variation in the proportion of the area saved from farm to farm. The results are shown in graphic form in Figures 1, 2 and 3. No significant relationship was established between the area of cereals grown and the level of investment in drying and storage equipment. This is probably due to the difficulty encountered in this study in adjusting the data from each farm to a truly comparable basis.

### 5.1 Labour and Powered Machinery Requirements

The relationship between labour and powered machinery (tractors, combines and lorries) and the area grown is shown in Figure 1. The requirements for both elements have been consolidated into a single curve for all cereals since only two farms, which have been excluded, had different requirements for labour and machinery. No distinction is made between winter and spring crops because of the small difference in requirement between them (see Table 5). The result of the analysis is a typical "reverse J" curve where a clear advantage is shown in a reduction in requirement as the area increases at the lower end of the scale, but after about 140 hectares (346 acres) there is only a slight improvement as the area increases. There is, however, no evidence of disadvantages of size beginning to operate at the top end of the scale.

### 5.2 Investment in Machinery

The relationships between the area grown and the investment in combines and drills, and general machinery (other than tractors) are shown in Figure 2. The data for combines and drills have been consolidated into a single curve because the pattern of investment in these two main pieces of specific field equipment is similar. The results show that there is no advantage here as the area grown increases because, for reasons already given, farmers at the lower end of the scale have a smaller investment per hectare in combines. The curve for investment in other machinery, on the other hand, does show a reduction as the area grown increases up to about 180 hectares (445 acres) grown. Taken together, however, the advantages of size exhibited by the curve for general machinery are offset by disadvantages shown by the one for combines and drills.

### 5.3 Fixed Costs

The result of the analysis of the relationship between the area of cereals grown and the level of fixed costs is given in Figure 3. Contract charges are included in the fixed costs for the reasons given in Chapter 4. Here two groups are evident, one with a high and one with a low cost structure with a statistically significant difference between their means. The coefficients of variation drawn on the graph at the 95 per cent confidence limit indicate slightly more variation in the "high cost structure" than in the "low cost structure" group. Within either group, however, no statistically significant relationship was found between fixed costs per hectare and the area of cereals grown.

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<sup>7</sup> Regression analyses using graphical/statistical techniques.

Above 80 hectares (198 acres) all farms fell into the "low cost structure" group, but between 30 and 80 hectares (74 and 198 acres) they were to be found in both the "high" and "low cost" groups. Between these limits whether the farm was in the "high" or "low cost structure" group depended not on the area of cereals grown but on the farmer's efficiency in managing the fixed resources.

FIG. 1 LABOUR AND MACHINERY REQUIREMENTS FOR WINTER AND SPRING CROPS (EXCLUDING STRAW SAVING)

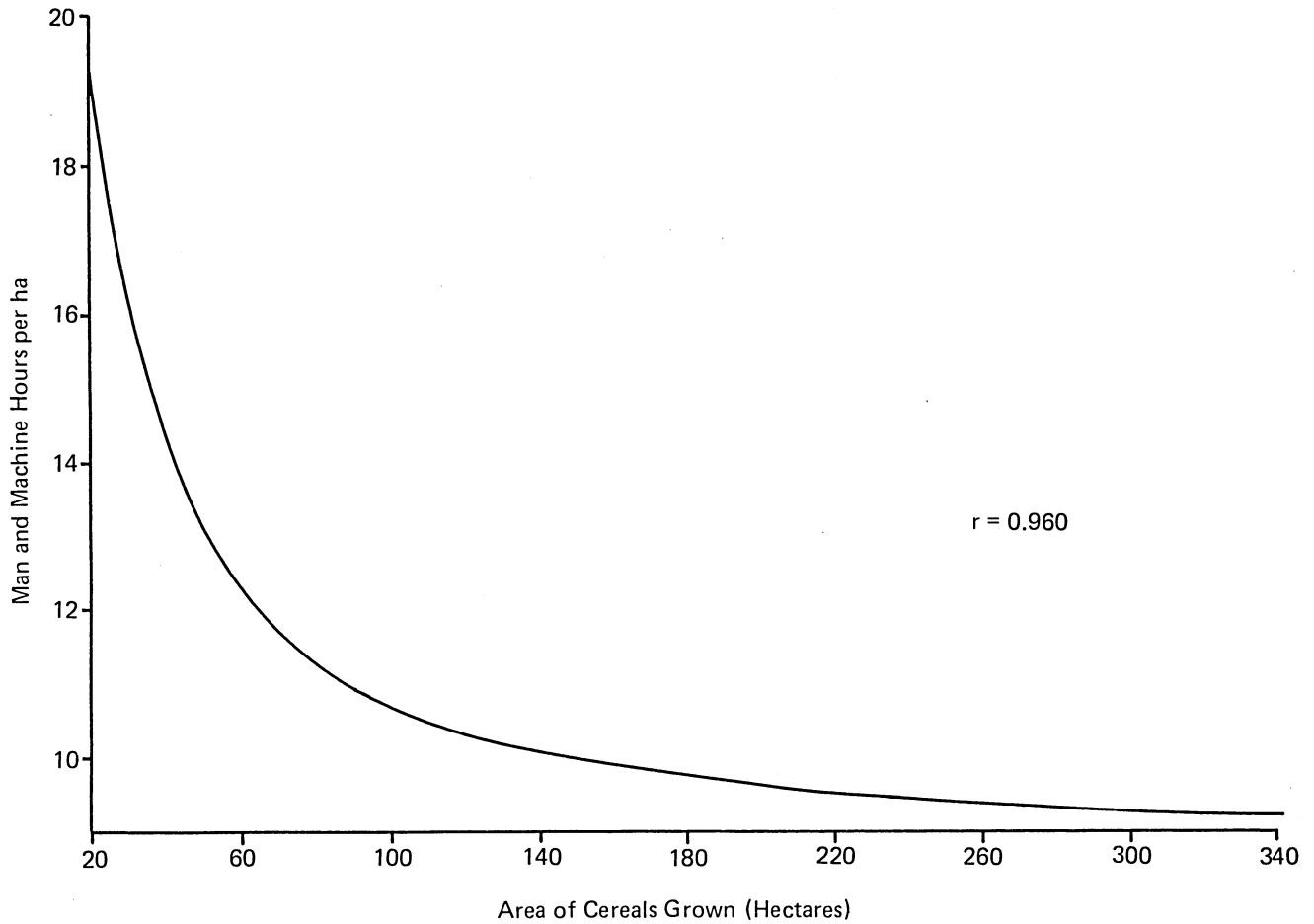


FIG. 2

INVESTMENT IN COMBINES & DRILLS  
AND GENERAL MACHINERY

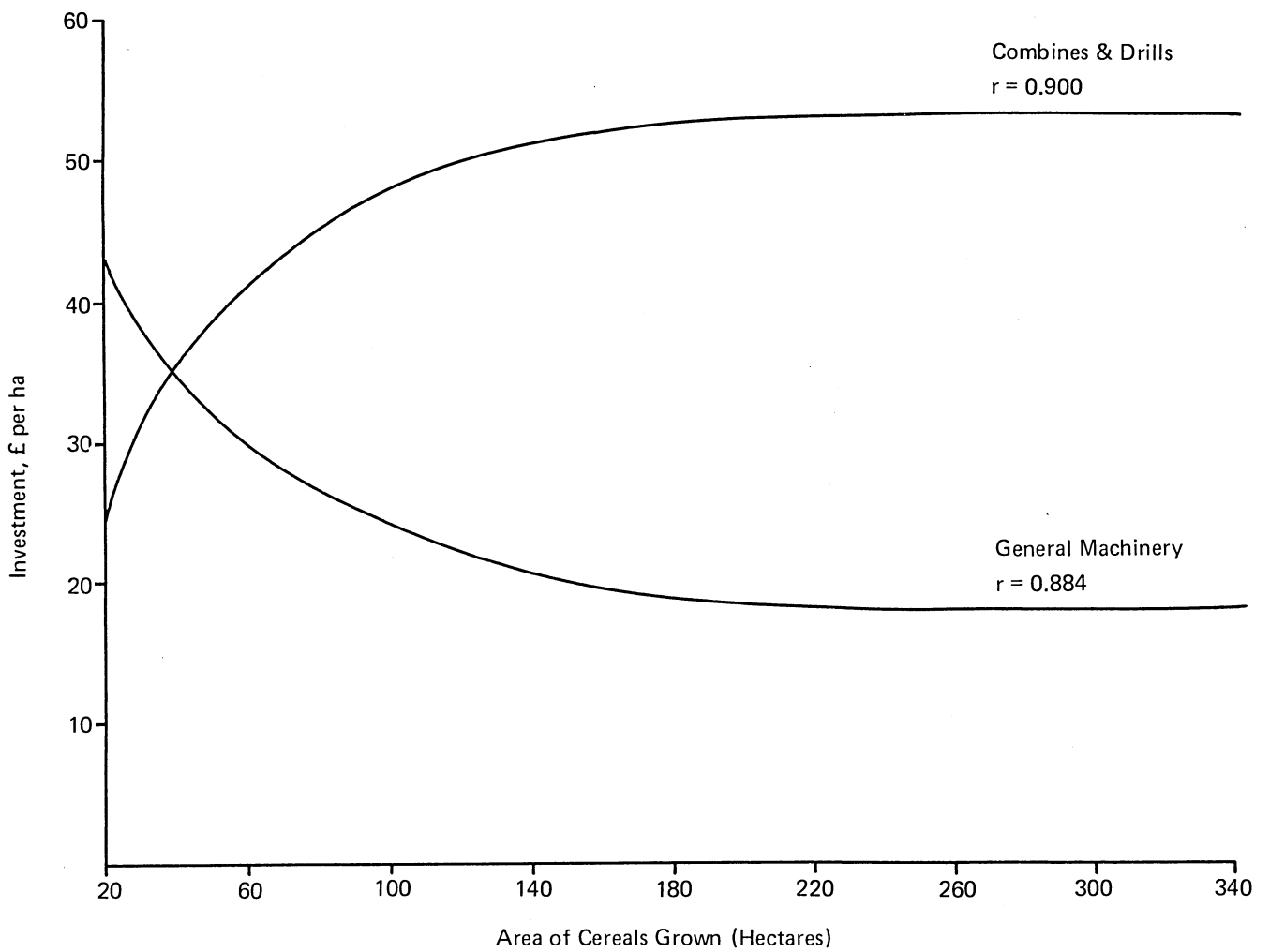
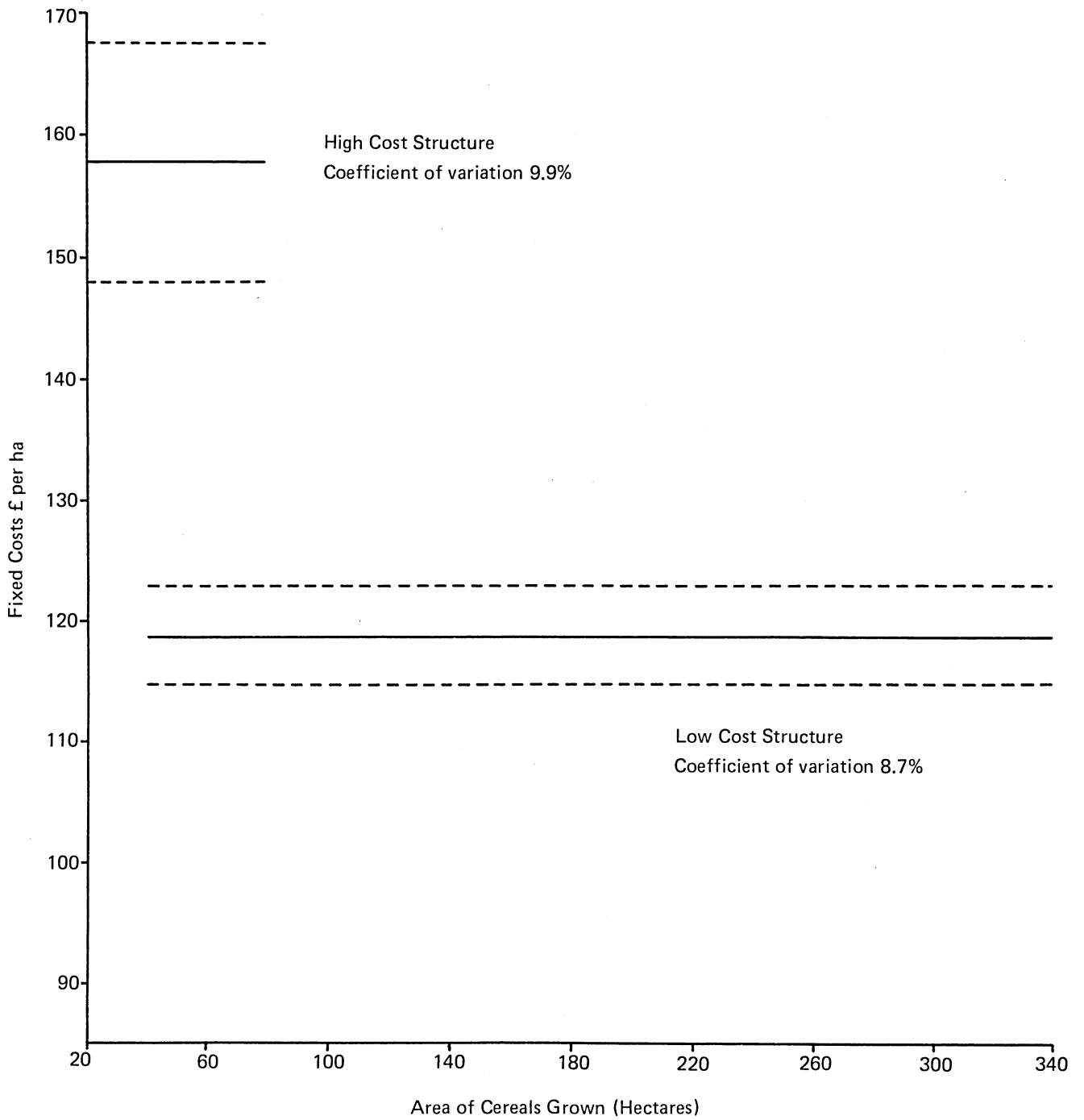




FIG. 3

FIXED COSTS (EXCLUDING STRAW-SAVING)



Key: — Mean  
----- 95% confidence limits

## 6. CONCLUSION

The results of this study do not reveal any striking change in the method of growing cereals. Conventional cultivations were used universally, only a very small area was direct-drilled and nobody was using the technique as a routine. No large bale machines were used for saving straw when the data was collected but an extension of the use of this new method would undoubtedly have been found in the 1976 and 1977 seasons.

Although size of operation in itself gives some advantage in promoting the more efficient use of fixed resources, there are also opportunities for farmers growing smaller areas (but over 20 hectares) to offset these disadvantages. This can be achieved by purchasing second-hand machinery, particularly combines, and by keeping machinery longer. Capital investment can also be reduced by employing contractors for harvesting.

Over 80 hectares (200 acres) of cereals grown, a low cost structure is related directly to the size of operation. But between 30 and 80 hectares (74 to 200 acres) the efficiency with which fixed resources are deployed determines whether the cost structure is high or low despite the fact that clear advantages of size are shown up to around 140 hectares (350 acres) in the physical requirement for labour and powered machinery.

It was shown that one drill and one combine were adequate to handle up to a limit of around 200 hectares (500 acres) of cereals. It might be expected that disadvantages of size might show up around distinct break points such as this. They do not appear, however, because there are the same opportunities for offsetting the disadvantages as there are on the smaller areas and some adjustment can usually be made to the area grown to suit the circumstances.

## APPENDIX 1

TABLE 1

### INVESTMENT IN STRAW-SAVING EQUIPMENT PER HECTARE SAVED

£ per hectare saved

Size Group				All Farms
1	2	3	4	
10.32	8.83	5.97	7.27	7.28

TABLE 2 *FIXED COSTS ATTRIBUTED TO GRAIN PRODUCTION AND STRAW-SAVING  
(excluding Contractors Charges)*

£ per hectare grown

	Size Group				All Farms
	1	2	3	4	
Grain Production	130.44	128.15	114.75	119.10	119.15
Straw-Saving	15.82	12.23	9.12	11.24	10.80

£ per hectare saved

Straw-Saving	16.01	15.26	13.61	18.31	15.68
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TABLE 3

### CALCULATED TRACTOR COSTS AT 1976 PRICES

£

	Size of Tractor		
	Under 50 h.p.	50 to 80 h.p.	Over 80 h.p. <sup>(6)</sup>
Average Cost New at 1976 Prices	4,084	5,262	10,910
Depreciation <sup>(1)</sup>	583.43	751.71	1,558.57
Repairs <sup>(2)</sup>	204.20	263.10	545.50
Fuel oil and lubricants <sup>(3)</sup>	200.00	260.00	390.00
Total <sup>(4)</sup>	987.63	1,274.81	2,494.07
Cost per Hour <sup>(5)</sup>	1.10	1.42	2.77

(1) 7 years straight-line.

(2) 5% of cost.

(3) Fuel @ 6.16p per litre (28p per gal)      Under 50 h.p.      50-80 h.p.      Over 80 h.p.  
3.41 litres/hr.      4.55 litres/hr.      6.83 litres/hr.      + lubricants

(4) Tax and Insurance is not included here because it is allowed in figures given for General Overheads in Table 15.

(5) Assuming annual usage of 900 hrs.

(6) Three-quarters of the tractors of over 80 h.p. were tracklayers and on one farm four Caterpillar D4's were employed.

TABLE 4 INDEXES USED FOR UP-DATING MACHINERY AND BUILDING PRICES

Year	Machinery	Fixed Equipment Buildings
1956	71.9	66.66
1957	74.9	69.44
1958	75.5	69.44
1959	75.7	68.52
1960	77.3	69.44
1961	77.9	70.37
1962	78.6	75.92
1963	79.2	78.70
1964	81.0	79.63
1965	83.6	82.41
1966	84.7	85.18
1967	86.7	87.96
1968	92.23	92.59
1969	100.00	100.00
1970	104.31	105.55
1971	114.22	112.96
1972	125.08	125.00
1973	141.88	151.85
1974	176.63	192.59
1975	220.46	234.25
1976	240.72	263.88

Source: MAFF Economics Division 1.

TABLE 5 COMPARISON BETWEEN DIFFERENT METHODS OF CALCULATING DEPRECIATION

	Size Group				All Farms
	1	2	3	4	
	Historic – Diminishing Balance	5.78	9.71	9.59	10.67
Current Cost – Diminishing Balance	30.00	36.00	25.11	24.29	26.37

£ per hectare

## APPENDIX 2

### (i) Depreciation Rates

#### (a) *Diminishing Balance Depreciation Rates Used for Machinery*

Machine	%
Tractors	30
Sprayers	30
Lorries	25
Combine Harvesters	20
Balers	20
Other	12½

#### (b) *Straight-line Depreciation Length of Life for Fixed Equipment and Buildings*

Fixed Equipment	10 years
Buildings	15 years

### (ii) Contract Charges (Recorded charges plus 20%)

Ploughing	£14.83 per hectare (£6.00 per acre)
Dragging	£23.72 per hectare (£9.60 per acre)
Drilling	£ 7.41 per hectare (£3.00 per acre)
Spraying	£ 6.47 per hectare (£2.62 per acre)
Combine Harvesting	£16.21 per hectare (£6.56 per acre)
Baling	8.4p per bale
Lorries (without driver)	£ 2.25 per hour

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