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Tractors

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ECONOMIC FACTS ABOUT TRACTORS

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ECONOMIC FACTS ABOUT TRACTORS

Department of Agricultural Economics
University of Nottingham School of Agriculture
Sutton Bonington, Loughborough.

NOVEMBER, 1952.

ECONOMIC FACTS ABOUT TRACTORS

The 20th century is often spoken of as the machine age; the term being used chiefly with reference to factory production. But in many ways this term applies with even more relevance to farming - the range of machinery which has come to be considered necessary on many farms having expanded considerably since the century began. Among those machines which are now almost thought of as being essential on most farms is the tractor - and even where it is not considered essential it is frequently installed for other cogent reasons. This attitude of mind towards tractors has only existed during the past decade or so, and is exemplified by the six fold increase that has occurred in the number of tractors on farms in England and Wales since 1939.

The introduction of a tractor, however, is not without its problems. Amongst those which might be listed are:- what amount of capital will be required to buy the tractor? what are the alternative uses of this capital? will the tractor replace any horses and, if so, how many? what difference will the tractor make to current farm expenses and more important to current net income? and what is the expected working life of the tractor? This report based on the actual experience of farmers in the East Midlands⁽¹⁾ attempts to answer some, but not all, of these questions. The first two sections are based on two enquiries conducted amongst farmers and the third on the analysis of published statistics.

PART I Costs of Running Tractors

When a farmer is considering whether to introduce a tractor onto his farm, the financial considerations he ought to take into account are as follows:-

1. The expenses likely to be incurred in running the tractor. These are of two kinds - variable and fixed costs. The former vary with the amount of work done and are represented by fuel and oil and repairs while the latter remain fixed irrespective of the volume of work and are represented by depreciation, taxation and insurance.
2. The direct savings in costs that can be made as a result of getting rid of horses.
3. The indirect effect on costs of production resulting from substituting a tractor for horses e.g. the effect on the labour requirements, either total or seasonal.

(1)

The East Midlands Province of the Agricultural Economics Advisory Service comprises the counties of Derbyshire, Leicestershire, Nottinghamshire, Lincolnshire (parts of Kesteven and Lindsey) and Rutland.

4. The effect on the gross revenue from the farm. This should be increased as a result of the release of land, which had previously been required for feeding the horses, for other productive uses. There may also be an effect resulting from the substitution - for example, higher yields because of better and more timely cultivations.
5. The combined effect of all the above on the net revenue likely to be obtained from the farm. If the expenses of the tractor are more than counterbalanced by savings elsewhere, or by savings plus increased gross revenue, then the introduction of the tractor will be economic.
6. The additional capital requirements of the tractor and the necessary implements and the possibility of obtaining these requirements. Too frequently the thought exists that to mechanise a farm all that is required is to purchase a tractor. The use of a tractor with horse equipment is very inefficient and causes operating costs to be considerably higher than when tractor equipment is used. Consequently a farmer about to mechanise must consider not only the capital requirements of a tractor but also of the implements which will be used with it.

Obviously no general rule exists to determine whether or not the introduction of a tractor will be economic. All that can be done is to consider each farm separately, bearing in mind all the relevant details, since these will vary from farm to farm. Information based on other farms, however, is sometimes of great help in evaluating a particular circumstance. This is especially so with regard to the likely cost of running a tractor, since an individual farmer who has never had one will have no experience on which to base an estimate. In order to obtain information on this subject, costs of running tractors were obtained from 22 farmers for the 12 months February 1951 to January 1952. Altogether information relating to 38 tractors was obtained from these 22 farmers. Of the tractors three were petrol, one diesel and the rest T.V.O. driven, although several of the latter were converted from petrol during the accounting year.

The co-operating farmers provided information on the fuel consumed, work done and costs of repairs, taxation and insurance. Standard charges were applied for fuel and oil and for the cost of labour for servicing and repairs (Appendix I). All tractors were depreciated at $28\frac{1}{8}$ per cent of the written down value, irrespective of the year of purchase or the amount of work performed.

The average cost of running the 38 tractors for the year was £144. 9s. (Table 1). Of this total, fuel and oil comprised £79.18s. (or 55 per cent), repairs £19.18s. (14 per cent) and depreciation £42. 2s. (29 per cent). The average hours worked were 925, so that the cost per hour came to 3s. 1½d. For the three most common types of tractors, namely Fordson Major, Fordson Standard and Ferguson, the costs per hour worked out at 3s. 1d., 3s. 3½d. and 3s. 6d. respectively. The cost per hour of fuel and oil for the three types, however, only ranged from 1s. 9½d. to 1s.11½d. so that most of the difference in total costs was caused by variations in depreciation and repairs.

AVERAGE COST OF RUNNING A TRACTOR FOR 12 MONTHS.
38 TRACTORS ON EAST MIDLANDS FARMS FEBRUARY 1951 TO JANUARY 1952

TABLE 1

	£. s.	Per cent
Fuel and oil	79.18.	55
Repairs	19. 8.	14
Depreciation	42. 2.	29
Tax and insurance	3. 1.	2
TOTAL COSTS(1)	144. 9.	100

Number of hours worked: 925

(1) Excluding interest on capital.

A considerable range was found to exist in the cost of running tractors. Thus the lowest cost was £32. 9s. for a tractor which only worked 197 hours, whilst the highest was £319.16s. for a petrol-driven tractor which worked 1,407 hours.

For a farmer considering the purchase of a tractor, the average cost of running a large number of tractors provides some guide to possible costs on his farm, but a grouping of tractors according to a range of costs provides much more information.

Over 60 per cent of the tractors had total costs of less than £160, (Table 2). The most frequent rate of cost was £80-£119 - although in fact all the nine tractors in this group had costs between £90 and £110. The least frequent rates were in the high cost groups, there being only two tractors in each of the two highest groups.

DISTRIBUTION OF TRACTORS BY RANGE OF TOTAL COSTS
38 TRACTORS ON EAST MIDLANDS FARMS FEBRUARY 1951 TO JANUARY 1952

TABLE 2

Range of total costs	Number of tractors	Fuel and oil	Repairs	Depreciation	Total costs*	Hours worked
		£. s.	£. s.	£. s.	£. s.	
Under £80	7	33. 1.	9.16.	14.11.	59.19.	332
£ 80-£119	9	59.10.	12. 1.	22.13.	96.14.	730
£120-£159	7	70. 7.	23.10.	32.13.	129.14.	928
£160-£199	6	90. 2.	21. 5.	65.10.	180. 2.	1,035
£200-£239	5	123.15.	41.17.	51.17.	220.16.	1,505
£240-£279	2	118. 2.	10.18.	111. 0.	243.14.	1,363
£280-£319	2	192. 0.	18. 6.	95. 9.	309.10.	1,640

*Includes taxation and insurance in addition to the other three items

Part of the reason for some tractors having higher total costs than others was obviously due to higher fuel costs, although greater depreciation charges were a contributory factor. Fuel charges vary with the amount of work done and to a lesser extent on the type of fuel used. Depreciation, on the other hand, is dependent solely on the purchase price and year of purchase of the tractor; thus the newer the tractor and the higher the purchase price, the greater is the amount of depreciation. Conversely, the older the tractor and the lower the price at which it was bought the lower the depreciation.

In order to study the effect of fuel costs on total costs, the records were grouped according to their level of total fuel costs. (Table 3). A definite relation was found to exist between fuel costs and total costs; as the former rose so did the latter, but not always to the same extent, the differences being due to variations in the charges for repairs and depreciation. The data also suggested that tractors with high fuel costs worked more hours than those with lower costs. In order to find out whether this was so, the records were regrouped on the basis of the number of hours the tractors worked during the year. (Table 4). A close relationship was found to exist between the number of hours worked and both the cost of fuel and oil and the total cost of running the tractor; the greater the number of hours worked the higher being the costs. At the same time costs per hour fell rapidly as the number of hours worked increased.

In conclusion, it can be said that whilst the average cost of running a tractor was £144. 9s. the most frequent rate was between £90 and £110. In fact only 15 of the 38 tractors (or 39 per cent)

DISTRIBUTION OF TRACTORS BY RANGE OF TOTAL FUEL COSTS.
38 TRACTORS ON EAST MIDLANDS FARMS FEBRUARY 1951 TO JANUARY 1952

TABLE 3

Range of fuel costs	Number of tractors	Fuel and oil	Repairs	Depreciation	Total costs*	Hours worked
		£. s.	£. s.	£. s.	£. s.	
Under £30	4	21. 1.	7.10.	22. 1.	53.10.	294
£30 - £59	11	47. 3.	20. 6.	28. 9.	98. 3.	621
£60 - £89	9	74.14.	10.19.	46.13.	135. 5.	945
£90 -£119	7	96. 3.	22. 9.	55. 7.	177.17.	987
£120-£149	4	131. 0.	41.19.	42. 8.	218.17.	1,476
£150-£239	3	188. 7.	19.19.	73.15.	285.16.	1,932

*Includes taxation and insurance in addition to the other three items.

DISTRIBUTION OF TRACTORS BY RANGE OF HOURS WORKED.
38 TRACTORS ON EAST MIDLANDS FARMS FEBRUARY 1951 TO JANUARY 1952

TABLE 4

Range of hours	Number of tractors	Fuel and oil	Repairs	Depreciation	Total costs*	Hours worked	Cost per hour
		£. s.	£. s.	£. s.	£. s.		s. d.
Under 400	5	30. 3.	10.12.	12.17.	55.11.	273	4. 2½
400-599	5	44.19.	6. 9.	30.10.	84.14.	482	3. 6½
600-799	8	69. 3.	20. 2.	52.12.	144.19.	726	3.11½
800-999	5	76. 5.	15. 5.	40. 8.	135. 2.	857	3. 2.
1,000-1,199	6	91.18.	31. 2.	40.17.	166.16.	1,088	3. 1.
1,200-1,499	5	113.16.	24.13.	48.19.	190.19.	1,317	2.10½
1,800-2,599	4	151.13.	26. 1.	67.10.	249. 4.	2,040	2. 6.

*Includes taxation and insurance in addition to the other three items.

had costs greater than the average. Similarly with regard to fuel and oil, the average cost was £79.18s. but the most frequent rate was £30-£59. In both instances the average was affected by a small number of records with very high costs. For a farmer considering the costs likely to arise as a result of buying a tractor, therefore, the better estimate of costs is provided by that which occurs most frequently rather than by the average.

Type and seasonality of work done by tractors.

Considering all tractors together, the average number of hours worked during the 12 months was 925. There was considerable variation between tractors, however, the extremes being 149 and 2,516 hours respectively.

When the tractors were grouped in 200 hour intervals the group which contained the largest number of tractors was that of 600-799 hours.

During the year the tractors spent an average of 96 per cent of their time on draw-bar work and four per cent on belt-work. (Table 5)

TYPE OF WORK PERFORMED BY 38 TRACTORS ON EAST MIDLANDS FARMS
FEBRUARY 1951 TO JANUARY 1952

TABLE 5

	Hours	Per cent
Ploughing	153	16
Cultivating - Harrowing and rolling	108	12
Dragging and scuffling	49	5
Ridging	15	2
Hoeing	10	1
Total cultivating	182	20
Drilling seed and fertilisers	72	8
Reaping and mowing	76	8
Raking and baling	35	4
Lifting roots	26	3
Total field-work	544	59
Carting - General	123	13
Harvest, hay and silage	88	10
Roots and fodder	70	8
Manure	59	6
Total carting	340	37
Belt-work	41	4
Total	925	100

Of the individual items, the comprehensive group "cultivating" was the largest, followed closely by ploughing and at a distance by general carting and then carting of the hay, silage and corn harvests. Very little belt-work was done by the tractors - a total of 41 hours during the year. Some belt-work was done in all months, but most in the months of September to February inclusive.

As regards the seasonal distribution of tractor work as a whole, the months of greatest use were April, October and September in that order. (Table 6). Least use was made of the tractors in February, although November and December ran February very close in this respect.

The average number of hours the tractors worked per day, excluding Sunday, varied from two in February to five in April and was not therefore excessive in any month.

SEASONAL DISTRIBUTION OF HOURS WORKED BY 38 TRACTORS
ON EAST MIDLANDS FARMS FEBRUARY 1951 TO JANUARY 1952

TABLE 6

	Hours	Per cent
February	51	6
March	64	7
April	125	13
May	77	8
June	65	7
July	80	10
August	66	7
September	105	11
October	108	12
November	52	6
December	58	6
January	64	7
	925	100

PART II. General Information with Regard to Tractors.

In the early part of 1951 an enquiry was conducted amongst 150 farmers in the East Midlands to obtain some general information about the tractors on their farms. This section is concerned with the analysis of this information⁽¹⁾.

Number of tractors per farm.

As was expected, the number of tractors per farm was found to increase as the size of the farm increased. (Table 7)

(1)

For a preliminary analysis vide:

Barker H.F. "Tractors on Farms in the East Midlands". Farm Management Notes No.7. Department of Agricultural Economics, University of Nottingham. 1952.

NUMBER OF TRACTORS PER FARM, 150 EAST MIDLANDS FARMS, 1951

TABLE 7

Tractors \ Acres	1-50	51-100	101-200	201-300	301 and over	All groups
	-----N u m b e r o f f a r m s-----					
1	28	17	7	3	1	56
2	8	16	14	13	2	53
3	-	4	5	3	8	20
4	-	-	-	3	6	9
5	-	-	-	-	3	3
6	-	-	-	-	3	3
7	-	-	-	-	4	4
8 or more	-	-	-	-	2	2
TOTAL	36	37	26	22	29	150

What was surprising , however, was the number of farms with more than one tractor. Even in the smallest size group over one fifth of the farms came in this category, and over the sample as a whole almost two thirds of the farms. At the same time it can be said that the most typical number of tractors per farm is one, although there was not very much difference between the number of farms with one and the number with two tractors. As a result, the average number of tractors per farm for the whole sample was 2.2 with a variation from 1.3 in the smallest to 4.5 in the largest size group.

Year of purchase of tractors by present owners.

Since the enquiry was made in the early part of 1951, the last complete year for which information was available with regard to tractor purchases was 1950. This was the year in which the greatest proportion of tractors on the farms was bought, though there was little to choose between that and each of the two preceding years. (Table 8). In fact for the sample as a whole over half the tractors had been bought by the present owners since the beginning of 1948. The variation between groups was not excessively great, but more of the tractors on the smallest farms had been bought within this period than was the case on the largest farms.

The average length of time that the tractors had been in the possession of their present owners, however, was greater than this, being four and a half years for all tractors. (Table 9)

PERCENTAGE DISTRIBUTION BY YEARS OF PURCHASE OF TRACTORS
OWNED BY 150 EAST MIDLANDS FARMERS

TABLE 8

Year \ Acres	1-50	51-100	101-200	201-300	301 and over	All groups
	----- P e r c e n t -----					
1951	2	8	2	10	3	5
1950	20	21	16	14	16	17
1949	20	10	14	14	16	15
1948	16	15	16	18	12	15
1947	7	11	16	4	15	12
1946	7	7	8	14	9	9
1945-43	18	15	8	18	8	11
1942-40	4	11	14	6	13	11
1939-29	6	2	6	2	8	5
TOTAL	100	100	100	100	100	100
No. of tractors	44	61	50	50	131	336

AVERAGE LENGTH OF OWNERSHIP OF PRESENT TRACTOR AND PERCENTAGE
OF TRACTORS BOUGHT NEW, 150 EAST MIDLANDS FARMS, 1951.

TABLE 9

Size group acres	Average length of owner- ship of present tractor Years	Tractors bought new Per cent
1-50	4.3	48
51-100	4.1	67
101-200	4.8	82
201-300	4.0	84
301 and over	4.8	84
All groups	4.5	76

This average length of time was greatest in the middle and largest size groups and least in the group coming in between, but the difference between the highest and the lowest average figures was only nine months.

This figure of average length of ownership is not to be confused with that of average age of the tractors. If all tractors had been bought new

by their owners the two figures would have been the same, but this was not the case. Thus only 48 per cent of tractors in the smallest size group were bought new whilst in the two largest size groups 84 per cent were so bought. It follows that the figure for the average length of ownership is much closer to that of average age in the largest than in the smallest farm size groups.

Farmers' expectations of the total life of their tractors.

In order to obtain some idea of the total life of tractors every farmer was asked to estimate the future life, either on his farm or elsewhere, of each of his tractors. When this estimate was added to the period of time that the farmer had already owned the tractor an estimate was available of the total life of tractors. To the extent that some tractors had had previous owners the "total expectation of life" obtained was an underestimate. In order to overcome this, a second calculation was made for those tractors which had been bought new by their present owners. Unfortunately estimates of future life were not forthcoming for all tractors and the samples were consequently smaller than for previous analyses.

Farmers' expectations of the total life of their tractors from the time they bought them ranged about ten years. (Table 10).

FARMERS' EXPECTATIONS OF THE TOTAL LIFE OF THEIR TRACTORS
FROM THE TIME THEY BOUGHT THEM, 150 EAST MIDLANDS FARMS, 1951

TABLE 10

Size group Acres	All tractors(1)		Tractors bought new	
	Expected total life years	Number of tractors	Expected total life years	Number of tractors
1-50	10.3	41	11.5	17
51-100	10.2	47	11.2	30
101-200	10.0	38	10.2	34
201-300	8.3	29	8.2	25
301 and over	9.7	64	9.9	55
All groups	9.8	219	10.1	161

(1)

For which information was available.

The estimates for tractors bought new were slightly greater than those for all tractors, but except for the two smallest size groups there was

very little difference between the two sets of estimates. This was due to the fact that only in these groups was any considerable proportion of tractors bought second hand. Estimates of total life tended to fall as size of farm increased but the decline was not great, except in the 201-300 acre group.

Individual estimates of the total life of tractors bought new varied considerably. (Table 11). The extremes were two years and 24 years, but over two thirds of the estimates lay within the seven year range of six to 12 years. Considering the different size groups this range contained two thirds or more of the estimates in all but the 101-200 acre group, whilst in the 201-300 acre group it contained over three quarters. This preponderance was undoubtedly due in part to a tendency for farmers to estimate the future life of their tractor from the time of the enquiry at either five or ten years.

FARMERS' EXPECTATIONS OF THE TOTAL LIFE OF THEIR TRACTORS FROM THE TIME THEY BOUGHT THEM NEW, 150 EAST MIDLANDS FARMS, 1951

TABLE 11

Acres Years	1-50	51-100	101-200	201-300	301 and over	All groups
	P e r c e n t					
2	-	-	-	4	-	1
3	-	-	-	4	-	1
4	-	-	-	-	4	1
5	-	-	9	8	6	5
6	6	7	15	12	13	11
7	6	3	6	16	13	9
8	18	10	9	20	9	12
9	-	17	9	4	9	5
10	-	7	11	12	2	6
11	23	17	9	8	11	12
12	12	10	3	4	13	9
13	17	10	11	-	7	9
14	-	3	-	-	3	2
15	6	7	6	8	3	5
16	-	3	6	-	3	3
17	6	-	-	-	-	1
18	-	3	3	-	2	2
19	-	3	3	-	-	1
20	6	-	-	-	-	-
24	-	-	-	-	2	1
TOTAL	100	100	100	100	100	100
No. of tractors	17	30	34	25	55	161

Prices at which farmers bought their tractors.

The price which a farmer has to pay for a tractor varies most according to whether he buys a new or second hand one and according to the make he buys, and to a lesser extent according to the time when he buys. Apart from farms in the smallest size group the most common price paid was between £301 and £400 and the second most common was between £101 and £200. (Table 12). In the smallest size group these positions were reversed.

PERCENTAGE DISTRIBUTION OF TRACTORS BY PURCHASE PRICE.
150 EAST MIDLANDS FARMS 1951

TABLE 12

Acres Price	1-50	51-100	101-200	201-300	301 and over	All groups
	P e r c e n t					
£50 and under	5	2	4	2	2	2
£51 - £100	23	2	2	6	-	4
£101-£200	34	32	22	18	16	23
£201-£300	4	15	16	12	19	15
£301-£400	27	36	52	38	32	36
£401-£500	7	8	4	14	7	8
£501-£600	-	5	-	8	11	6
£601 and over	-	-	-	2	13	6
TOTAL	100	100	100	100	100	100
No. of tractors	44	61	50	50	133	338
Average price	£ 209	£ 273	£ 275	£ 313	£ 390	£ 317

The average price paid for tractors was £317, but the average prices for the different farm size groups ranged from £209 to £390. This variation in average prices was largely due to the different proportion of tractors bought second hand - 52 per cent in the smallest and only 16 per cent in the largest size group - and to the variation in the type of tractor bought and consequently in the price, as the size of farm gets larger. In this connection it is interesting to note that the average price of tractors bought second hand ranged from £122 to £168 in all size groups except the largest, in which it was £385. This very high price in the 301 acres and over group was caused by six of the 21 tractors having been bought for over £500 - two of them for over £1,000.

Makes and types of tractors

A surprisingly large number of makes and types of tractors were found on the 150 farms - there being altogether 26 different types. Overall the Fordson Major took pride of place with 28 per cent of the total number, but it was run very close by the older Standard with 26 per cent. (Table 13). On farms of under 100 acres, however, it was the Fordson Standard which took pride of place, and the Fordson Major came third, after the Ferguson. These three tractors between them accounted for 70 per cent of the tractors on the farms surveyed - the other 30 per cent being made up of 23 different types. Naturally there was more variation in types on the larger than on the smaller farms, the greatest variation being found on the 301 acres and over group. In this group 18 different makes and types were found in addition to those mentioned in Table 13.

MAKES OF TRACTORS ON 150 EAST MIDLANDS FARMS, 1951

TABLE 13

Make \ Acres	Number of tractors					
	1-50	51-100	101-200	201-300	301 and over	All groups
Fordson Major	7	9	20	20	38	94
Fordson Standard	20	23	16	11	18	88
Ferguson	8	12	7	7	20	54
David Brown Cropmaster	6	8	2	5	1	22
Nuffield	-	1	-	2	9	12
Farmall M.	-	1	1	-	7	9
Others (20 makes)	3	7	4	5	40	59
TOTAL	44	61	50	50	133	338

Rubber-wheeled tractors were far and away the most common. (Table 14) Over half the tractors in the sample were four-wheeled tractors on rubbers and a further fifth were of the rowcrop type, also on rubbers. Relatively speaking, rubber-wheeled tractors were of least importance on farms with the smallest and largest acreages, but for different reasons. On the smallest farms many of the Fordson Standard tractors had steel wheels, while on the largest farms there were a number of tractors with some kind of tracks. Over the whole sample, track-laying tractors were comparatively unimportant and even in the largest size group they only made up a tenth of all the tractors.

PERCENTAGE DISTRIBUTION OF TRACTORS ACCORDING TO TYPE
OF TRACTION, 150 EAST MIDLANDS FARMS, 1951

TABLE 14

Type.	Acres	Per cent					All groups
		1-50	51-100	101-200	201-300	301 and over	
Rubber wheels		51	56	58	68	53	56
Rubber wheels (rowcrop)		21	23	19	11	22	20
Steel wheels		26	19	19	9	13	17
Steel wheels (rowcrop)		2	2	2	6	1	2
Tracks		-	-	2	3	9	4
Half tracks		-	-	-	3	2	1
Total		100	100	100	100	100	100
No. of tractors		43	57	48	35	127	310

PART III. Replacement of Horses by Tractors

To measure the effective rate of replacement of horses by tractors is one of the most difficult tasks facing anyone considering the introduction of tractors to a particular farming system. Several attempts have been made(1) and generally speaking the results have shown replacement ratios below the commonly accepted theoretical figure of one tractor for four horses. In all probability the discrepancies have been due to three main causes:-

1. A difference may exist between the apparent and the effective displacement of horses, the latter being greater than the former. Thus a farmer may not get rid of his horses immediately he buys a tractor, but may keep them until he sees how the new power unit works. Further, even when a farmer has got rid of all the horses of which he wishes to dispose, those he retains may do less work than they did before the introduction of the tractor. In either of these events the apparent displacement would be less than the effective.

(1)

Vide e.g. Dudman. R.A. "Of Horses and Tractors". The Farm Economist. Vol.VI. No.7. 1950.

Evans, D.H. "Horses on Farms Today". Department of Agricultural Economics, University of Nottingham. 1951.

Plant, Sheila "Horse Displacement and Land Liberation resulting from the Introduction of a 'Standard' Tractor". The Farm Economist Vol.VI. No.10. 1951.

2. The difficulty of determining a suitable measure of replacement. Several measures can be used e.g. changes in total numbers of tractors and horses, of the number of tractors and horses per 1,000 acres of crops and grass, of arable or of tillage. Each of these measures has its advantages and disadvantages and each is likely to give a different replacement ratio. Essentially a measure should show the replacement ratio for work which both do, but since the tractor may do work which the horse cannot such a measure becomes impossible. The only thing, therefore, is to give the best indication of the replacement rate according to several measures and then try to draw some general conclusions from the results.
3. As mechanisation becomes more common and tractors are introduced onto smaller farms the replacement ratio of horses by tractors is bound to become smaller. Thus if a farmer who normally keeps two horses buys a tractor, the number of horses that tractor can displace is limited to two, unless the farmer hires it out on contract and so enables other farmers to reduce their horses. Since there are few farms with exactly four, or multiples of four, horses there is bound to be quite a considerable discrepancy between the theoretical and the actual replacement ratio for this reason alone.

Between 1939 and 1952, according to the measure of total numbers, every tractor that was introduced onto farms in the East Midlands displaced just over one horse. (Table 15) Thus the number of tractors increased from 4,958 in 1939 to 32,523 in 1952, or by 27,565, while the number of agricultural horses fell from 57,938 to 20,950, or by 36,988.

NUMBER OF AGRICULTURAL HORSES DISPLACED BY EACH TRACTOR
INTRODUCED IN THE EAST MIDLANDS, 1939 TO 1952

TABLE 15

Area	1939 - 1946		1946 - 1952		1939 - 1952	
	Total numbers	Per 1,000 acres arable	Total numbers	Per 1,000 acres arable	Total numbers	Per 1,000 acres arable
Derbyshire	0.8	10.3	2.0	2.5	1.4	5.3
Nottinghamshire	1.1	3.2	1.9	2.1	1.5	2.7
Leicestershire	0.6	14.1	2.1	1.4	1.1	6.7
Lindsey	1.1	2.1	1.7	1.8	1.4	1.9
Kesteven	1.0	2.4	1.6	1.8	1.3	2.1
Rutland	0.7	4.8	1.3	1.3	1.0	2.7
East Midlands	0.9	3.5	1.8	1.8	1.3	2.5
England & Wales	0.9	4.3	1.6	1.4	1.2	2.5

The decrease in horse numbers was therefore 1.3 times as great as the increase in tractor numbers, or every tractor displaced 1.3 horses. The same displacement rate was found to exist per 1,000 acres of crops and grass, but per 1,000 acres of arable the displacement rate was almost twice as great. Considering individual counties, the highest displacement rate occurred according to the first two measures in Nottinghamshire, followed closely by Lindsey, Derbyshire and Kesteven in that order. But per 1,000 acres of arable the greatest displacement occurred in Leicestershire and Derbyshire, these counties being followed at a considerable distance by Nottinghamshire and Rutland. Obviously this last measure is greatly affected by the increase that occurred in the arable acreage - two fold in Leicestershire and one fold in Derbyshire - and yet in many ways it provides the best measure of motive power requirements on farms.⁽¹⁾

If the period 1939 to 1952 is divided at 1946, very different results are obtained for the two parts. Thus for the East Midlands as a whole the displacement rate - measured either in total numbers or per 1,000 acres of crops and grass - was twice as great between 1946 and 1952 as between 1939 and 1946. But because the great increase in arable acreage occurred before 1946, the displacement rate per 1,000 arable acres was twice as great during the war as in the years since. Further there was very much less variation between counties, according to this latter measure, in the replacement rate between 1946 and 1952 than there was in the earlier years.

The apparent replacement rate of horses by tractors can thus be seen to vary according to the measure used and the time period chosen. Apart from the rate per 1,000 acres of arable between 1939 and 1946, it would seem that each tractor introduced onto farms in the East Midlands has displaced between one and two horses, on the assumption that they are not in any sense complementary to each other in farm work. This replacement ratio is well below the theoretical and is taken as evidence that farming is over mechanised. Is this actually so? The obvious answer is yes, since if tractors are not working to full capacity fewer tractors would suffice and therefore farming is over mechanised. But to the individual farmer it is a matter of little concern if his tractor is capable of doing more work than it actually does. Most farmers are concerned with maximising their incomes and not with obtaining the greatest possible work output from their tractors. It does not follow that the latter will not bring about the

(1)

For a statement of the relationship between arable acreage and hours worked per tractor see Jones. W. Dyfri. "A Study of Tractor Costs on Welsh Farms", Department of Agricultural Economics, University College of Wales, Aberystwyth 1952. p.5.

former - but to do so may require a complete reorganisation of the farm business. As a general rule, the economic criterion by which to determine whether the introduction of a tractor is worthwhile is, Will the farm income be greater with the tractor than without? and not Will the tractor be used to its maximum potential? The answer to the latter question may frequently be in the negative, but provided that to the former is in the affirmative the introduction of a tractor will be economic.

Conclusions

This report was concerned with only one of the economic considerations a farmer has to take into account when deciding whether or not to change from horses to tractors, namely with the costs of running a tractor. Great variations were shown to exist in this cost, these variations occurring in each of the three major items of expense, namely fuel and oil, repairs and depreciation. Of the three, the variations in the cost of fuel and oil were the greatest, due to differences in the amount of work performed.

Attention was drawn to the fact that the final criterion by which to judge the economic worth of a tractor was its effect on the net income of the farm. If this is increased as a result of introducing a tractor, then the latter is economic irrespective of the costs incurred in running it. But if the net income is decreased, the farmer would be better off without the tractor, unless non-monetary considerations play a more important part in determining his course of action.

A.W.A.

A P P E N D I X I

STANDARD CHARGES AND PROCEDURES ADOPTED IN THIS INVESTIGATION

Labour

Labour spent on home repairs and daily servicing was charged for at 2s. 6d. per hour.

Fuel and oil

The following charges were made:-

Petrol	3s. 7d. per gallon
T.V.O.	1s. 4d. " "
Diesel oil	1s. 2d. " "
Oil	7s. 3d. " "
Grease	16s. 3d. per 14 lbs.

Depreciation

All tractors were depreciated at 28 ¹/₈ per cent of the written down value, irrespective of the year of purchase or amount of work done. This method resulted in a few very old tractors being written down to a value below scrap price; for these tractors an arbitrary charge was made on the grounds that if full information had been available on repairs and renewals over their life their written down value would not have been so low.

Repairs

Repairs that only maintained the working conditions of the tractor without prolonging its life were charged in full. But the costs of those repairs that prolonged the life of the tractor, such as a new engine or new tyres, were added to the written down value of the tractor at the beginning of the year and then depreciated in the normal way. Consequently only a proportion of those costs which prolonged the life of the tractor were charged to the year in question.

APPENDIX II COSTS OF RUNNING 38 TRACTORS ON EAST MIDLANDS FARMS, FEBRUARY 1951 TO JANUARY 1952

Code No.	Tractor make	Petrol	T.V.O.	Oil	Total fuel and oil	Repairs	Depreciation	Tax and insurance	Total costs	Hours worked	Cost per hour
		£. s.	£. s.	£. s.	£. s.	£. s.	£. s.	£. s.	£. s.		s. d.
1	Ferguson	86.14.	-	5.11.	92. 5.	34.13.	56.13.	5. 0.	188.11.	789	4. 9 $\frac{1}{4}$
1A	Ferguson	227. 6.	-	4.16.	232. 2.	19. 0.	66.14.	2. 0.	319.16.	1,407	4. 6 $\frac{1}{2}$
2	Fordson Major	10.19.	58.11.	5.14.	75. 4.	4.17.	13.11.	4. 5.	97.17.	915	2. 1 $\frac{1}{2}$
	Fordson Major	8.13.	59.13.	3. 5.	71.11.	3.13.	16.15.	4. 5.	96. 4.	767	2. 6.
	Fordson (Tracks)	4. 7.	20.11.	1. 9.	26. 7.	18. 1.	25.19.	-	70. 7.	352	4. 0.
3	Fordson Major	3. 4.	28. 3.	18.	32. 5.	5. 4.	52.12.	15.	90.16.	449	4. 0 $\frac{1}{2}$
4	Fordson	1.14.	30. 7.	7.10.	39.11.	13. 9.	5. 2.	-	58. 2.	299	3.10 $\frac{1}{2}$
	International	15.	11. 7.	2. 3.	14. 5.	6. 6.	19.10.	3.10.	43.11.	149	5.10
5	Fordson Major	1.14.	48.12.	5. 5.	55.11.	43. 7.	31. 7.	3. 5.	133.10.	821	3. 3.
8	Caterpillar D.2	1.14.	57. 4.	5. 5.	64. 3.	23. 6.	110.12.	15.	198.16.	1,168	3. 4 $\frac{3}{4}$
	Fordson Major	16. 3.	151. 5.	13.14.	181. 2.	23. 4.	30. 7.	3.15.	238. 8.	2,516	1.10 $\frac{3}{4}$
	Massey Harris	18.14.	64. 5.	12.17.	95.16.	24.19.	5. 7.	3.15.	129.17.	1,219	2. 1 $\frac{1}{2}$
9	Fordson	4. 8.	45. 6.	3. 9.	53. 3.	37.17.	12.11.	-	103.11.	615	3. 4 $\frac{1}{2}$
	John Deere	10. 2.	56.18.	2.19.	69.19.	12.10.	39.14.	3.10.	125.13.	1,246	2. 0.
11	Fordson Standard	10. 6.	37. 5.	5.19.	53.10.	12.11.	4.14.	3. 8.	74. 3.	486	3. 0 $\frac{1}{2}$
13	Fordson Major	16. 3.	71. 2.	7.10.	94.15.	6. 0.	68.11.	4. 0.	173. 6.	735	4. 8 $\frac{1}{2}$
	Fordson Major	19. 0.	83.11.	8.16.	111. 7.	5. 6.	122.18.	4. 0.	243.11.	863	5. 7 $\frac{3}{4}$
16	Ferguson	105.11.	10.17.	6. 7.	122.15.	28. 0.	34.15.	3.15.	189. 5.	1,024	3. 8 $\frac{1}{4}$
17	Fordson Standard	8.14.	76.16.	8.12.	94. 2.	17.17.	13.16.	3.15.	129.10.	1,072	2. 5.
18	Farmall	4. 7.	55.13.	4.11.	64.11.	12.17.	127.19.	3. 5.	208.12.	764	5. 5 $\frac{1}{2}$
20	Farmall A	5. 1.	44.16.	2.14.	52.11.	22.14.	11.16.	3. 8.	90. 9.	1,146	1. 7.
	Nuffield	9.19.	109. 4.	5.14.	124.17.	16.10.	99. 1.	3. 8.	243.16.	1,863	2. 7 $\frac{1}{2}$
	International	9.14.	124. 9.	14.10.	148.13.	47. 0.	16. 6.	3. 8.	215. 7.	1,910	2. 3 $\frac{1}{4}$
21	Case D.C.4.	8.12.	77. 6.	8.14.	94.12.	49.16.	65. 5.	4.18.	214.11.	1,228	3. 6.
25	Ferguson	4. 2.	29. 7.	5. 2.	38.11.	1.11.	94. 5.	3. 5.	137.12.	682	4. 0 $\frac{1}{2}$
	Fordson Standard	1.12.	12. 4.	2.15.	16.11.	2.19.	9.14.	3. 5.	32. 9.	197	3. 3 $\frac{1}{2}$
28	Field Marshall	-	17. 8.	9.12.	27. 0.	2.15.	33. 2.	4.15.	67.12.	479	2. 9 $\frac{3}{4}$
31	Moline G.T.	10. 9.	71. 3.	7.10.	89. 2.	12.14.	5.15.	15.	108. 6.	831	2. 7 $\frac{1}{4}$
	Allis Chalmer. U.	11. 1.	119.17.	21. 1.	151.19.	17.12.	124. 5.	5. 8.	299. 4.	1,873	3. 2 $\frac{1}{4}$
	Moline G.T.A.	10. 4.	105. 8.	12. 1.	127.13.	76. 7.	19. 8.	3.13.	227. 1.	1,109	4. 1.
	Ferguson	13.18.	50.11.	12. 5.	76.14.	16.19.	67.14.	3.13.	165. 0.	1,487	2. 2 $\frac{1}{2}$
	Allis Chalmer.U.	2.17.	66.17	10. 7.	80. 1.	7.14.	5.17.	18.	94.10.	571	3. 4.
33	Fordson Standard	10. 4.	31.19.	11.19.	54. 2.	12. 7.	3.18.	3. 0.	73. 7.	367	4. 0.
36	Fordson Major	8.19.	68. 4.	3.18.	81. 1.	4. 5.	32. 8.	4.10.	122. 4.	764	3. 2 $\frac{1}{2}$
	David Brown	5.11.	23. 8.	2.16.	31.15.	3.18.	56. 5.	4.10.	96. 8.	424	4. 6 $\frac{1}{2}$
37	Fordson Major	13.14.	72. 7.	4. 2.	90. 3.	18.10.	54.15.	2. 6.	165.14.	1,008	3. 3 $\frac{1}{2}$
	Fordson Standard	7. 0.	45. 9.	4.18.	57. 7.	60. 3.	11.16.	5.	129.11.	696	3. 8 $\frac{3}{4}$
43	Ferguson	47.16.	-	2. 3.	49.19.	10. 0.	28.11.	3.16.	92. 6.	853	2. 2.

