Dairying

PRODUCTIVITY AND EFFICIENCY OF LABOUR USE
on North of England small Dairy Farms

G. H. BRAYSHAW, M.A.

Report 140 M.
january 1960 5/-

UNIVERSITY OF DURHAM
Department of Agricultural Economics
KING'S COLLEGE, NEWCASTLE UPON TYNE

PRODUCTIVITY AND EFFICIENCY OF LABOUR USE

on North of England small Dairy Farms

UNIVERSITY OF DURHAM
Department of Agricultural Economics
KING'S COLLEGE, NEWCASTLE UPON TYNE

Much of the field work for this investigation was carried out by
W. G. R. WEEKS and W. T. DAVISON.

CONTENTS.

INTRODUCTION.

The purpose of the investigation on which this report is based was to consider ways of saving labour, and to obtain some idea of their importance as means to greater profitability on dairy farms in the North of England.

Fifty two farms varying in size from 38 to 192 acres were included in the investigation, but because of the influence of acreage on methods, outputs and profits, the data obtained was separated into three groups according to farm size and analysed separately:—

Group	Average Acreage	Number of Farms
0—80 acres	60	18
81—120 acres	96	19
121—200 acres	158	15

On each farm dairying was the main enterprise, grassland predominated, and although differing widely in intensity there was great similarity in other respects.

CHAPTER 1

THE IMPORTANCE OF PRODUCTIVITY

Productivity may be simply defined as the ratio of output to input, and labour productivity as the ratio of output to labour input.

An increase in productivity implies greater efficiency in the use of resources, greater profit per unit of output, but not necessarily a high profit. At any particular level of prices the total profit obtained depends on both productivity and on intensity. Even with high productivity low inputs will lead to disappointing profits.

An increase in labour productivity may easily be offset by reduced efficiency in the use of other resources. For example, a new building or a machine may increase labour productivity, but profits will be reduced if its annual cost exceeds the annual value of the labour that it saves.

An increase in labour productivity should not then be regarded as an end in itself, nor as a guarantee of greater profit, but rather as an important step towards that end.

The importance of productivity, and of intensity, is indicated by major differences between costs and returns on the farms investigated. The structure of outputs and costs within each size group together with levels of stocking and cropping for the year 1956/57 are summarised in the tables in Appendix 1. The results designated "Premium" refer to the 25% most profitable farms, those designated "High Output" refer to the 25% most intensive farms.

Profits tend to be greater on the more intensive farms, but the very high profits obtained on premium farms can not be fully explained by intensity.

The most probable relationships between inputs and outputs are shown in Figure 1.

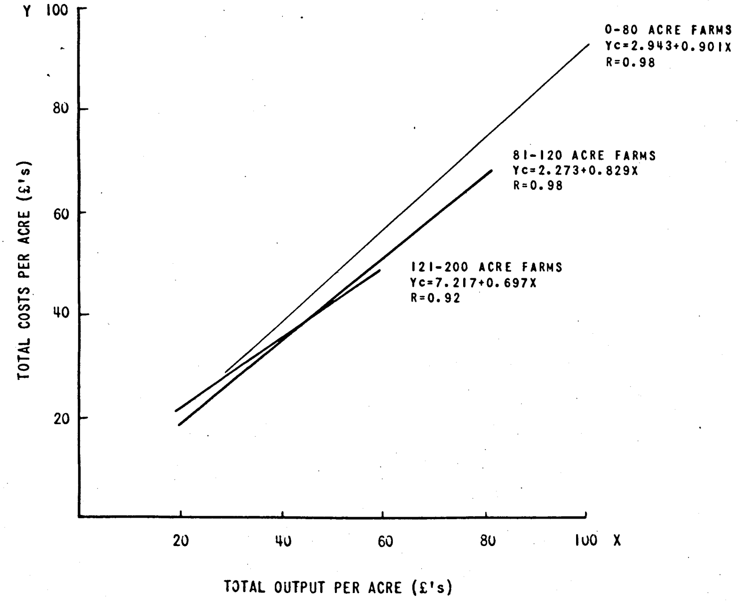


FIGURE 1.

A tendency towards diminishing returns on 0—80 acre farms with very high outputs was found to have no statistical significance, and within the observed limits of output the relationships were in each case found to be linear.

The ratios of output to input expressed as a percentage of this ratio on the average 0—80 acre farms give the following productivity indices:—

ACREAGE GROUP	0—80	81—120	121—200
Average	100	109	110
High Output	102	110	118
Premium	112	115	124

Productivity is apparently little affected by differences in intensity on the farms below 120 acres, and the relationships for these farms in Figure 1 are therefore uninfluenced by differences in productivity. In contrast, the larger farms with a high output tend to use resources more efficiently. The slope of the curve for large farms in Figure 1 would otherwise be steeper, and the income strictly attributable to intensity should therefore be rather less at all levels of output.

Correlating incomes, outputs and productivities suggests that the extra profits made on the premium and more intensive farms can be attributed to intensity and productivity as follows:—[1]

GROUP	Income per acre in Excess of Group Average	Explained by Intensity	Explained by Productivity	Unexplained Variation
0—80 acres				
Premium Farms	6.9	0.4	6.0	0.5
High Output Farms	2.4	1.2	0.9	0.3
81—120 acres				
Premium Farms	4.2	1.9	2.1	0.2
High Output Farms	2.5	2.3	0.1	0.1
121—200 acres				
Premium Farms	6.2	1.7	4.3	0.2
High Output Farms	5.2	2.4	2.4	0.4

The incomes resulting from exceptionally high productivity do not of course reflect its potential importance. but only its relative importance on the sample farms. They suggest that differences in productivity are an important cause of differences in profitability, and that on both the small and large farms investigated profits were influenced more by productivity than by very wide differences in intensity. This emphasises the care that is needed in the use of feed and labour, particularly on small farms where greater reliance on purchased feeding stuffs makes efficiency in the use of feed very important, and where there is often difficulty in providing just the right amount of labour to meet requirements.

0—80 acres, $Xc_{1 \cdot 23} = -46.61 + 0.04X_2 + 0.47X_3$; $R_{1 \cdot 23} = 0.96$,
F value significant at 0.001% level.

81—120 acres, $Xc_{1 \cdot 23} = -39.51 + 0.13X_2 + 0.36X_3$; $R_{1 \cdot 23} = 0.97$,
F value significant at 0.001% level.

121—200 acres, $Xc_{1 \cdot 23} = -35.96 + 0.15X_2 + 0.32X_3$; $R_{1 \cdot 23} = 0.98$,
F value significant at 0.001% level.

Where X_1 = Income per Acre.
X_2 = Total Output per Acre.
X_3 = Productivity.

Price Reductions and the importance of Productivity

Productivity is important not only as a means of increasing incomes at all levels of output, but also to maintain output, employment and income in a time of increased competition, reduced demand and falling prices. This is illustrated in the following table which shows the effect of a fifteen per cent reduction in prices on incomes per acre:—

ACRES	0—80		81—120		121—200	
GROUP	Income per acre	Income if 15% reduction in prices	Income per acre	Income if 15% reduction in prices	Income per acre	Income if 15% reduction in prices
Average	2.4	-4.8	6.3	-0.3	5.7	0.1
High Output	4.6	-6.8	8.6	-0.1	10.8	3.2
Premium	9.1	0.6	10.4	2.1	11.9	4.8

The farms of less than 120 acres using resources with only average efficiency would become unprofitable, and would survive only if these farmers were prepared to farm for less return than the wages of an agricultural worker. The larger farms using resources with only average efficiency would make a small profit, but clearly the farmers achieving greater productivity would more easily survive such a situation.

If prices are good more intensive production is often an important means of increasing profits. If they are bad it is on the level of productivity that survival of the business largely depends.

Differences in Labour Productivity

The relationship between outputs and inputs of labour, purchased feedingstuffs and fertilizers for the sample as a whole indicates the average marginal productivity of these important inputs.[1] These suggest that although more intensive production may frequently be desirable, higher output should not be sought by using proportionately more of each of these inputs, but by using less labour, more feedingstuffs and more fertilizers.

It is in the use of these very inputs that farms of varying intensities and profitabilities chiefly differ. In each size group more purchased feedingstuffs, more fertilizers, and either the same or rather more labour are used on the farms with very high outputs. On the most profitable farms more purchased feedingstuffs are used, and a rather higher output is produced with the same or less labour. The following indices of labour productivity underline the influence of efficiency in the use of labour on their success:—

ACREAGE GROUP	0—80	81—120	121—200
Average	100	123	112
Premium	142	160	141
High Output	155	162	126

[1] $Xc_{1\cdot 234} = 17.17 + 0.49\ X_2 + 1.40X_3 + 3.50X_4$; $R_{1\cdot 234} = 0.91$, F value significant at 0.001% level.

Where X_1 = Total Output per Acre.
X_2 = Labour Costs per Acre.
X_3 = Purchased Feed Costs per Acre.
X_4 = Fertilizer Costs per Acre.

This is not to say that the use of more purchased feedingstuffs and fertilizers will always be more profitable, or that it would never be advantageous to employ more labour. Profitable use of extra feed or fertilizer depends both on sound technical management, and upon having stock and land capable of giving a satisfactory response. Similarly there will sometimes be jobs where it would be profitable to use either more labour, or a combination of more labour and other resources.

Nevertheless, on farms such as these greater profitability is firstly very dependent on the ability of the farmer to use more feed and fertilizer efficiently, and secondly on his ability to produce a high output at low labour cost. This investigation is concerned with the effect of the latter on labour productivity.

CHAPTER 2

PLANNING TO SAVE LABOUR AND INCREASE PRODUCTIVITY

Lower costs are not to be obtained simply by reducing the labour required for any job, but by saving time on particular tasks which occur at busy times of the year, and by adjusting the supply of labour to take advantage of the reduced requirements at these times.

Average labour requirements per 100 acres together with the regular labour available on the sample farms in each half month throughout the year are given in Appendix 2.

On the most profitable 0—80 acre farms the regular labour provided is about sufficient to meet needs in the Spring, and a little overtime or casual labour is required to harvest potatoes and at the height of the hay-making season.

On the most intensive small farms the labour regularly provided more than meets needs in the Spring, but some overtime or casual labour is required at hay time.

In contrast, on the average 0—80 acre farm more labour is regularly provided, and average labour requirements are lower, resulting in considerable surplus to direct crop and stock requirements.

On these farms the overtime and casual labour vary from about 250 man hours per 100 acres on the most profitable farms to 500 on the most intensive farms. In each case it more than fills seasonal shortages, the difference being partly required to provide a suitable number of men for those jobs that are best done by a team.

Allowing for differences in cropping and stocking it seems that on the average 0—80 acre farm the regular labour could be reduced by over 2,400 man hours a year per 100 acres without making it any scarcer than on premium farms in the critical June period. Similarly the casual labour could be somewhat reduced.

It would also appear that smaller but worthwhile savings could be made on the larger farms. For example, on the farms of more than 120 acres regular labour could on average be reduced by over 700 man hours a year per 100 acres without making labour in the more critical Spring period any scarcer than on premium farms in this size group. Casual labour could again be slightly reduced.

This may suggest that on many farms worthwhile savings could be obtained by reducing the labour force. However, it may not always be possible. On small farms in particular, labour may be wasted because the farm is not of a size to fully employ one or two men; or some farmers may prefer to employ at least one man rather than make more profit; or the family labour which seeks employment may exceed requirements. In most of these cases intensification provides an alternative means of increasing labour productivity. For example, on the intensive and more profitable 0—80 acre farms in the sample the productivity of labour is exceptionally high, although about the same labour is provided as on the average farms with much lower labour productivity.

Apart from providing just the right amount of labour the following are often suggested as ways of reducing labour costs:—

1. Reducing the regular labour force and relying more on casual labour or overtime.
2. The introduction of piece work and bonus schemes in order to encourage greater effort.
3. Cropping and stocking changes which will reduce labour requirements or seasonal fluctuations in the demand for labour.
4. Further mechanisation.
5. Reducing the regular labour force and having more work done by contract.
6. The introduction of new and improved work methods.

Casual labour is not always obtainable, and depending on the quality available, may sometimes prove to be expensive.

As an alternative, overtime is and must remain an important means of meeting seasonal demands for labour in Agriculture. If it does not lead to abuses, or to the working of an excessive number of hours, it is a good way of giving regular workers the opportunity of earning more money.

Neither method offers any general means of saving labour. Whether greater reliance on casual labour would be advantageous depends on the locality, and particularly on small farms where much of the labour is provided by the farmer himself, it is frequently more important for him to find means of reducing overtime, and to have more time in which to plan and to manage his business efficiently

Piece work and bonus payments based on Work Measurement may prove to be as valuable in Agriculture as in many other industries, and a wider use of incentive schemes is to be expected. As yet, however, there is very little accurate data available on which to base such schemes, and they are likely to be developed first on large farms. Of the bonus schemes in use some may be of value as a means of maintaining quality standards. None closely relate earnings to the amount of work done, and it is doubtful if they offer very much incentive to greater effort.

Cropping and Stocking Changes

Changes in cropping and stocking on these farms have been considered, both as a means of reducing labour requirements and of achieving a more even requirement throughout the year.

The periods of peak demand for labour usually fall in June, in August and October, and in the Spring. They are associated with hay and silage making, with the harvesting of oats and potatoes, and with lambing and the Spring cultivations which must often be undertaken before cattle are turned out onto grass.

All but the Spring peak are attributable to one crop or another. In contrast, heavy labour requirements in Spring arise from a wide variety of skilled jobs that must be carried out at this time. The later work may perhaps be mechanised, or carried out by unskilled casual labour, but the Spring work will in many cases ultimately dictate the size of the regular labour force.

On these farms both cows and sheep are profitable, and the value of the labour saved by reducing their numbers would not normally be sufficient to maintain farm income. Nor do any simple changes in cropping appear to offer much opportunity of saving labour and increasing profits.

To reduce labour peaks on the average 0—80 acre farms potatoes might be replaced by wheat, half the feed roots by kale, and a part of the hay acreage by silage:—

Cropping per 100 acres, 0—80 acre Average Farms

Crop	Actual Acreage	Proposed Acreage
Wheat	1.2	4
Oats	13.7	14
Potatoes	2.8	—
Kale	1.5	4
Feed Roots	4.3	2
Hay	29.6	17
Silage	3.5	16
Grazing	43.4	43
	100.0	100

This would reduce Spring and June labour requirements by about 22 and 43 man hours per 100 acres a half month. Thus without making labour any scarcer in the Spring the regular labour could be reduced by over 500 man hours per 100 acres a year. However, potato yield of seven tons per acre fully justify the extra labour:—

Additional Costs	£		Expenses Saved	£	
Wheat and Oat seed ...	6		Root seed	5	
Wheat and Oat fertilizer ...	12		Root fertilizer	14	
Kale seed	5		Potato seed	70	
Kale fertilizer	15		Potato fertilizer	28	
			Labour, 515 hours @ 3/6d. ...	90	
			Fuel	3	
		38			210
Receipts Foregone			**Additional Receipts**		
19.6 tons potatoes @ £15 per ton		294	67 cwts. wheat @ 28/- cwt. ...		94
			Decrease in Net Farm Income per 100 acres		28
		£332			£332

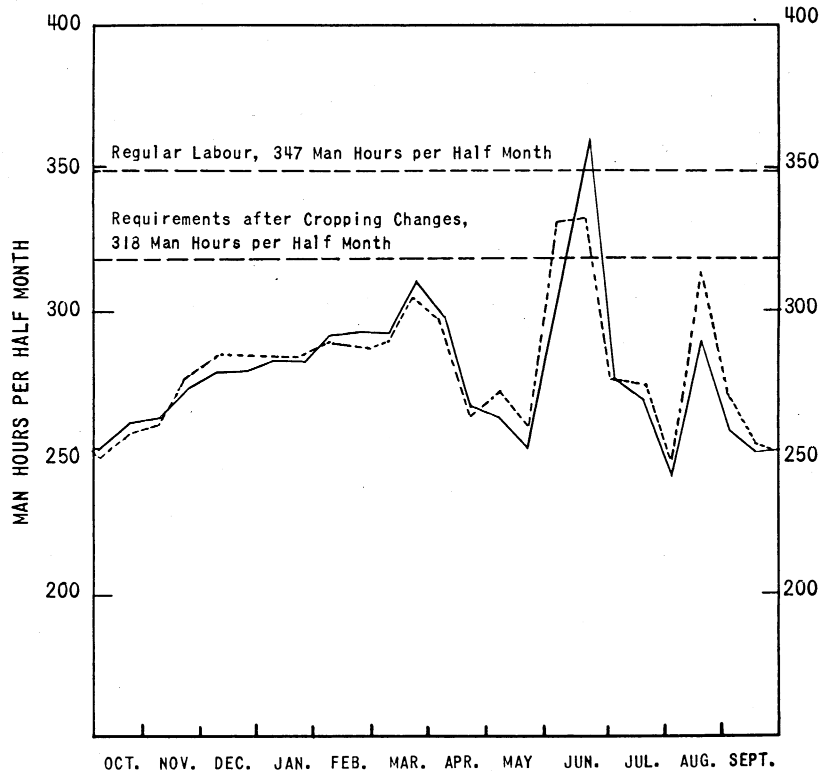


FIGURE 2. 0-80 Acre High Output Farms, Seasonal Labour Requirements per 100 acres before and after Cropping Changes.

Figure 2 suggests that on the more intensive small farms the regular labour to be supplied is governed more by June than by Spring requirements, and that some six or seven hundred man hours a year per 100 acres might be saved by growing the following proposed combination of crops:—

Cropping per 100 acres, 0—80 acre Intensive Farms

Crop	Actual Acreage	Proposed Acreage
Oats	5.8	6
Kale	3.4	4
Feed Roots	2.0	2
Hay	32.6	20
Silage	7.7	20
Grazing	48.5	48
	100.0	100

This would not be desirable if the more intensive farms differed from the average farms only in cropping. Cropping changes alone are unlikely to be very effective in increasing labour productivity on average farms of this type. To be effective they must be accompanied by stocking and policy changes which affect the economy of the farm as a whole.

It is just such a series of changes that have been carried out on the more intensive 0—80 acre farms. On these the tendency is to grow fewer potatoes and cereals, to specialise still further on the production of grass and milk, and to increase output by more specialised management, and by greater use of purchased feeding-stuffs. To increase both labour productivity and profitability each and every one of these steps seem to be necessary.

Further Mechanisation

Important jobs in June and August could be further mechanised, but because of their diversity, further mechanisation of the Spring cultivations implies the introduction of a number of larger implements and, in the majority of cases, more power. For those Spring jobs on which tractors are often operated below their optimum capacity there is a case for larger implements. Otherwise, remembering that on these farms cultivations account for little more than thirty per cent of the Spring work, further mechanisation of field work would not at present seem to be justified. As a special case of further mechanisation extension of contract work is limited by the need for timeliness in critical Spring cultivations. Once again, if it is to be effective in increasing labour productivity, mechanisation must be considered in conjunction with other changes of the type described.

It is concluded that the foregoing indirect ways of saving labour are reasonably well understood, and that their effectiveness may sometimes be over-emphasised.

CHAPTER 3

METHODS IMPROVEMENT AS A MEANS OF SAVING LABOUR IN THE BYRE

If the previous ways of reducing labour costs seem to offer very limited scope, the introduction of better methods appears to offer far more.

Figure 3 shows that on the smallest farms the labour required to tend stock greatly exceeds that required for cropping, that dairy cows use by far the most labour, and that very little time is occupied with sheep and pigs. This is also the case on the larger farms. Clearly it is particularly important for herd work to be well planned.

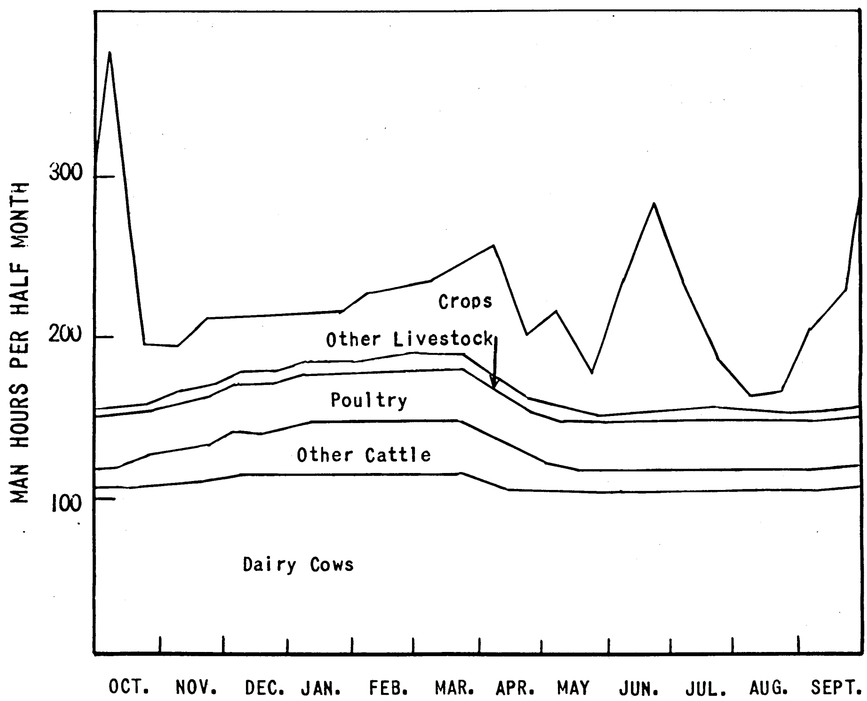


FIGURE 3. 0-80 Acre Farms, Average Seasonal Labour Requirements per 100 acres.

In the North few herds are as yet housed in yards. In the byres on the sample farms the average amount of labour used to tend each cow was found to be 88 man hours a year, of which 84 hours were worked and only 4 man hours were taken as relaxation allowance. It has been calculated, however, that breaks and rest pauses of up to 15% of the total time required are justified by the nature of herd work, and more properly 99 man hours a cow a year should be provided:—

	Minutes per Cow a Week	
	Winter	Summer
Milking	52	52
Dairy Work	20	20
Cleaning and Littering	17	4
Feeding	16	—
Other Work	3	15
Relaxation Allowance	19	16
	127	107

Man Hours for 20 Winter Weeks	...	42
Man Hours for 32 Summer Weeks	...	57
Man Hours per Cow a Year ...	...	99

On individual farms the time required to tend each cow varied from under 60 to 202 man hours a year. High labour use was associated with low profits, and low labour use with particularly high profits.

Despite some difference in labour requirements due to differences in herd sizes this variation indicates the labour that in many cases could be saved by re-organising herd work. Methods of achieving this are discussed in the following sections.

Milking

Rates of milking were found to vary between eight and twenty-seven cows per man hour, and averaged between 13 and 14 cows. Low rates were observed to result from a poor milking routine, an inefficient operator, the use of the wrong number of milking machines, or from over milking.

Most byres have one or two rows of standings and a dairy situated at one end. Suitable routines together with the labour needed to milk each cow in byres of different sizes are given in Appendix 3. In addition the average machine times required per cow are shown, assuming the machines to be correctly adjusted. From this information the number of machines that should be used, and the rates of milking to be attained, can be readily calculated:—

$$\text{Optimum Number of Machines} = \frac{\text{Average Machine on Time} + \text{Average Machine Off Time}}{\text{Average Man Routine Time per Cow}}$$

$$\text{Attainable Rate of Milking (Cows per Man Hour)} = \frac{\text{Number of Machines}}{\text{Average Machine on Time} + \text{Average Machine Off Time in Minutes}} \times 60$$

The following extreme examples suggest that a skilled man can be expected to milk between 25 and 41 cows a man hour in most byres with standings for up to

45 cows. Further examples of intermediate situations are given in Appendix 4:—

EXAMPLE 1.

Forty-five cows are milked in a single row byre and average abcut 700 gallons of milk a year. The milk is cooled over a surface cooler.

From Appendix 3:—

		Minutes
Average machine on time per cow	A.M.	4.46
	P.M.	4.13
Average machine off time per cow		0.39
Average man routine time per cow		1.97

Optimum Number of Machines

$$\text{A.M.} = \frac{4.46+0.39}{1.97} = 2 \text{ \& } 0.91 \text{ minutes for eventualities}$$

$$\text{P.M.} = \frac{4.13+0.39}{1.97} = 2 \text{ \& } 0.58 \text{ minutes for eventualities}$$

Attainable Rate of Milking

$$\text{A.M.} = \frac{2}{4.46+0.39} \times 60 = 25 \text{ cows a man hour}$$

$$\text{P.M.} = \frac{2}{4.13+0.39} \times 60 = 27 \text{ cows a man hour}$$

EXAMPLE 2.

Any number of cows milked in a single or double row byre and averaging about 1,000 gallons of milk a year, the milk being tipped to churns in the byre and in-churn cooled.

		Minutes
Average machine on time per cow	A.M.	5.45
	P.M.	4.79
Average machine off time per cow		0.39
Average man routine time per cow		1.41

Optimum Number of Machines

$$\text{A.M.} = \frac{5.45+0.39}{1.41} = 4 \text{ \& } 0.20 \text{ minutes for eventualities}$$

$$\text{P.M.} = \frac{4.79+0.39}{1.41} = 3 \text{ \& } 0.95 \text{ minutes for eventualities}$$

Attainable Rate of Milking

$$\text{A.M.} = \frac{4}{5.45+0.39} \times 60 = 41 \text{ cows a man hour}$$

$$\text{P.M.} = \frac{3}{4.79+0.39} \times 60 = 35 \text{ cows a man hour}$$

In a small byre little time is required to take the milk from each one or two cows to a surface cooler. If yields are high a skilled man can operate three machines efficiently, and can be expected to milk over 30 cows in an hour.

Using the same routine in a long shed or on low yielders it is difficult to operate more than two machines without over milking the cows, and it is not then possible for a man to milk more than 25 to 27 cows an hour.

In a long byre the time required to milk may sometimes be reduced by resiting the dairy half way along the building. For example, 45 cows averaging 1,000 gallons can be milked with three units at a rate of over 30 cows an hour in a single row shed with a central dairy. If the same herd averaged only 700 gallons the time saved with the dairy in a central position would not enable a skilled man to use three machines without some difficulty.

In the second example it is assumed that the cowman is equipped with a trolley to carry his equipment, that the milk is tipped to churns in the byre, and that it is taken to be in-churn cooled at convenient times during milking. A long single row shed or a badly situated dairy should not then greatly affect the time required to milk. A skilled man has ample time in which to operate three machines, and if they are correctly adjusted he should again milk more than 30 cows an hour.

With a typical herd averaging about 800 gallons a man using one of the two methods described in Appendix 3 should milk between 30 and 36 cows an hour:—

Byre	Method	Milking	Number of Machines	Attainable Rate of Milking
Small with convenient dairy.	(1)	A.M.	$\frac{4.79+0.39}{1.58} = 3$	$\frac{3}{4.79+0.39} \times 60 = 34.7$
		P.M.	$\frac{4.30+0.39}{1.58} = 2$	$\frac{2}{4.30+0.39} \times 60 = 25.6$
Large or with inconvenient dairy.	(2)	A.M.	$\frac{4.79+0.39}{1.41} = 3$	$\frac{3}{4.79+0.39} \times 60 = 34.7$
		P.M.	$\frac{4.30+0.39}{1.41} = 3$	$\frac{3}{4.30+0.39} \times 60 = 38.4$

Average Daily Rate of Milking

Method 1 $\frac{34.7+25.6}{2} = 30$ cows a man hour

Method 2 $\frac{34.7+38.4}{2} = 36$ cows a man hour

This does not mean that a skilled man can be expected to milk a herd of 36 cows in an hour, or of 72 cows in two hours. At the beginning and end of milking some of the machines are not in use. Allowing for this the rates attainable with 15, 30 and 45 cow herds are 26, 30 and 32 cows per man hour.

These are theoretical perfomances but they closely coincide with those attained on the sample farms where milking was particularly well organised. Allowing for dry cows, both theory and observation from the survey suggest that some

300 man hours per 100 acres a year are to be saved by reorganising milking on the average 0—80 acre farms, or about 280 man hours on the larger and less intensive holdings.

Dairy Work

Under this heading is included the preparation of equipment prior to milking, washing and chemically sterilizing the milking equipment, and getting the full churns ready for collection.

The average amount of labour used on these tasks was twenty minutes per cow a week. Much of this work is unaffected by differences in herd size. Therefore the variation in the work per cow was considerable:—

Number of Cows	Man Hours a Week	Man Hours per Cow a Week
15	7.1	0.47
20	8.1	0.40
25	9.0	0.36
30	10.0	0.33
35	10.9	0.31
40	11.9	0.30
45	12.8	0.28

Average figures such as these may be useful for making comparisons, but they are a measure of the labour used rather than required when the work is well planned and effectively carried out. The following standards, based on Work Study data obtained in this Survey, are a measure of the labour required using the methods outlined in Appendix 5:—

		Man Hours a Week			Man Hours Per Cow a Week		
	Number of Cows	15	30	45	15	30	45
Method of Milking	Position of Milk Stand						
1. Using 3 machines and a surface cooler.	Outside Dairy	4.7	5.4	6.0	0.31	0.18	0.13
	By Farm Gate	5.6	6.4	7.1	0.37	0.21	0.16
2. Using 3 machines and in-churn cooling.	Outside Dairy	3.7	4.5	5.2	0.25	0.15	0.12
	By Farm Gate	4.6	5.5	6.3	0.31	0.18	0.14

If milk can not be collected from the dairy the additional time required for transport to the farm gate will of course vary according to the distance. The times suggested relate to satisfactory performances over average distances.

In-churn cooling and a milking trolley have been suggested to allow one man to milk 12 or 13 more cows an hour in many large or inconvenient byres. The two examples in Appendix 5 show that in-churn cooling will save an hour's work in the dairy each week, and suggest that some two to three hundred man hours per 100 acres a year are to be saved by attaining the standards described in Example 2.

Feeding

In most cases the Winter ration on these farms is based on either roots and hay, or silage and hay. Each cow might be given some 14 lbs. of hay and 40 lbs. of roots, or 7 lbs. of hay and 40 lbs. of silage.

With a small herd a single row byre is not inconvenient for feeding, but for herds of more than about twenty cows a two row byre is, of course, ideal.

Satisfactory byre layouts for herds of different sizes are shown diagrammatically in Figure 4, and in Appendix 6 Process Charts are used to compare three alternative methods of feeding in them.

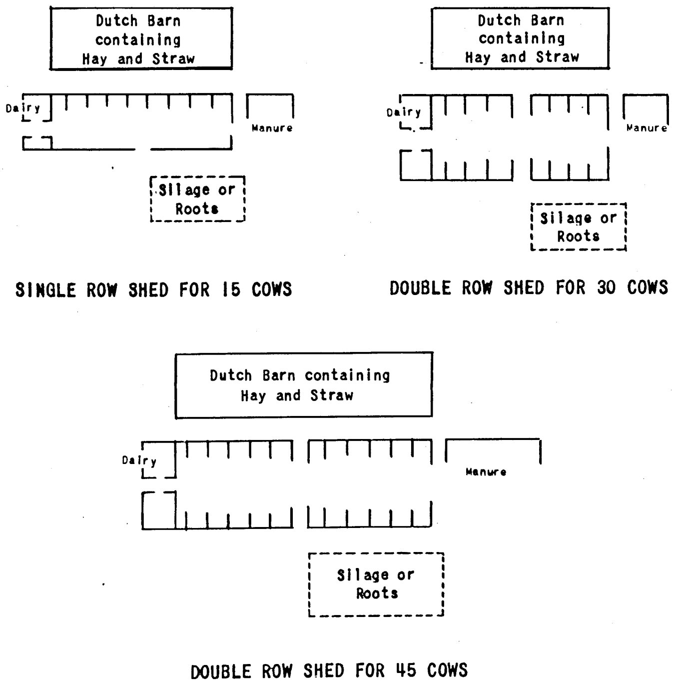


FIGURE 4.

Method One is not very different from the routine employed on many farms, but it assumes that both roots and hay are stored just outside the byre. It suggests that from one to three man hours a week might be saved in Winter according to herd size with the layouts and method described.

It is not the purpose of this report to consider revolutionary methods requiring substantial capital expenditure, but the several shortcomings in this very typical way of feeding roots and hay should certainly be mentioned.

The work of feeding, like cleaning and littering livestock, largely consists of moving materials from one place to another, and the introduction of better methods is very dependent on better handling of materials. For example, in the feeding of both roots and hay, time and effort are saved if feed is stored close by, and if it is brought into the byre in bulk. In addition Method One involves delays, bad machine utilisation, and some unnecessary handling.

Method Two is suggested as a possible alternative where it can easily be arranged for roots to be stored a few feet above the slicing machine. The roots are put onto a short conveyor instead of into skips, gravity fed into the machine, and allowed to fall from the machine into a low trolley. Hay also is brought into the byre on a trolley, and feeding can be carried out in little more than half the time that is usually taken.

In Method Three similar principles are applied to silage feeding, and there seems to be little difference in the labour required to feed roots and silage. If the clamp has been well sited, and the work is well organised, suitable amounts of silage and hay can be fed in rather less time than is required to feed roots and hay by Method One. With either ration there is scope for saving a large proportion of the time that is usually spent on feeding.

Cleaning and Littering

The work involved in cleaning out the byre varies very much according to the degree of cleanliness desired. In addition, there is wide variation in the quantities of straw supplied to the cows as bedding, and consequently in the work involved in both cleaning out and littering.

On farms where straw is scarce it is not uncommon to use as little as one bale a day for ten or twelve cows. If only badly soiled litter is removed, if care is taken to see that the bedding is kept as clean as possible, and if fresh straw is provided simply as an addition to the existing bedding, this practice appears to be satisfactory, and does save labour.

Where straw is less scarce 5 lbs. per cow a day is satisfactory. This is the quantity assumed in the routine described in Appendix 7.

Again this method is not very different from that used on many farms; but it assumes that both straw and manure will be stored conveniently close at hand, that no more straw than is necessary will be used, and that movements and the handling of materials will be reduced to the minimum necessary. It suggests that anything from two to six man hours of the labour normally used for cleaning and littering each week in Winter might be saved.

In Summer, with careful handling of the cows, there need be little manure to remove from the byre, and in many cases this is shovelled up in the spare moments which inevitably occur during milking. It is, of course, still necessary to swill and brush the byre floor. Using the same method the labour required for this job is much the same as in Winter, and only a small saving can be looked for compared with average performance.

Conclusions

Applying the methods and standards of the previous sections to a typical herd averaging about 800 gallons a year suggests the following performances to be attainable in most well organised byres:—

Man Minutes per Cow a Week (Byres)

	Average Performance		Attainable Performance					
Number of Cows	25		15		30		45	
Winter or Summer	W	S	W	S	W	S	W	S
Milking	52	52	32	32	28	28	26	26
Dairy Work	20	20	15	15	9	9	7	7
Cleaning and Littering	17	4	10	3	9	2	9	2
Feeding	16	—	11	—	10	—	10	—
Other Work	3	15	3	15	3	15	3	15
15% Relaxation Allowance	19	16	13	11	10	10	10	9
TOTAL	127	107	84	76	69	64	65	59
Man Hours for 20 Winter weeks	42		28		23		22	
Man Hours for 32 Summer weeks		57		40		34		31
Man Hours per Cow a Year	99		68		57		53	

These overall performances were in fact achieved on seventeen per cent of the farms investigated, and almost so on a further eight per cent. Reorganisation, and the attainment of these standards on the average small, medium and large farms investigated implies a reduction of 45, 43 and 40 man hours per half month per 100 acres respectively in Winter, and of 33, 31 and 30 man hours in Summer.

With a high output and a heavier level of stocking, the average quantities of labour to be saved on the small, medium and large farms amount to 53 man hours per half month per 100 acres in Winter and to 38, 39 and 40 man hours respectively in Summer.

The reduction in the regular labour provided which this may make possible will depend upon whether the requirement of labour is more critical in June or in early April, and on the date when cows can usually be turned out onto grass in the Spring.

If the requirement of labour is more critical in June, or if the cattle are usually turned out at the beginning of April, the average savings suggested as possible amount to approximately seven or eight hundred man hours per 100 acres a year.

If, on the other hand, labour is scarcer before cattle are turned out in the Spring, some 960 to 1,080 man hours per 100 acres might be saved in these ways according to farm size.

CHAPTER 4

YARDS AND PARLOURS

In addition to labour saving possibilities in traditional byres an obvious further consideration must be whether yards and parlours will effect even greater savings.

From observations elsewhere on a large number of farms it has been calculated that the average difference in the labour required in byres and in yards and parlours amounts to 28 man hours per cow a year. Only 58 man hours were required in the twenty-five per cent of cases where the least labour was used in conjunction with satisfactory methods.

The suggested standard of performance to be aimed at in byres was almost achieved on twenty-five per cent of the farms investigated, and to this extent these "premium" levels of performance for each system are roughly comparable. The figures for byres, however, assume that the methods and equipment which appear to be the most suitable will be used, and where this is so in well designed yards and parlours the evidence available suggests that it is reasonable to expect the following performances:—

Yards and Parlours

	Attainable Performance					
Number of Cows	15		30		45	
Winter or Summer	W	S	W	S	W	S
Man Minutes per Cow a week	78	58	63	45	55	39
15% Relaxation Allowance	14	10	11	8	10	7
TOTAL	92	68	74	53	65	46
Man Hours for 20 Winter weeks	31		25		22	
Man Hours for 32 Summer weeks		36		28		25
Man Hours per Cow a Year	67		53		47	

This assumes that the cows are milked with a suitable number of machines, and that they are housed in a single yard which provides just sufficient space for them and for storage of the straw, hay and self-feed silage required throughout the Winter. Five yard layouts which can satisfy these requirements are shown diagrammatically in Figure 5.

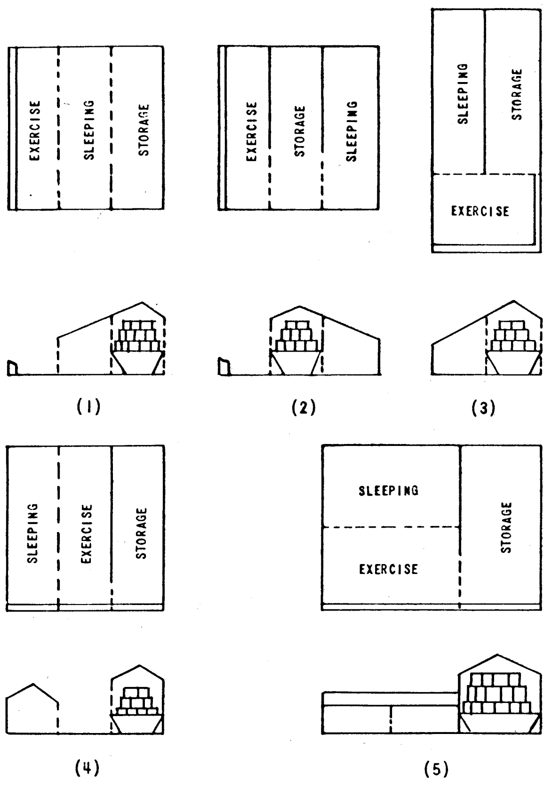


FIGURE 5.

The first arrangement has a disadvantage in that fodder must be fed in the littered sleeping area, or it must be carried across the yard to the manger. Nor can the yard be fully covered as simply and cheaply as in designs which have a high central storage area.

The second design is better in these respects. The littered portion of the yard is clear of the heavy traffic between the exercise and self-feeding areas. Fodder can be easily put into racks separating the storage and exercise areas, and straw can be thrown directly into the sleeping area from its storage position. In addition, the manger space required for any foods brought from elsewhere can be provided along the outside of the exercise area where it is directly accessible to a tractor and trailer. In the semi-covered version shown in the diagram the manger is not under cover, but full cover can be provided simply and cheaply by putting lean-to extensions on each side of the central storage barn.

The third design is also good, and offers most of the advantages to be sought in a modern yard. Similar to the second design, the fully covered version tends to be rather more expensive, and it is not as easy to find an accessible position for the length of manger that may be required. The particular merits of the design are in the simplicity with which self-feeding can be arranged, and in the ease with which the layout can be modified to enable larger numbers to be self-fed at each end of a dutch barn of limited width.

Requiring two separate covered areas, the fourth and fifth designs are more expensive. The fourth does not provide for an accessible manger situated well away from the sleeping area, or for the storage of straw where it can be thrown straight into the littered area. Despite this it provides reasonable efficiency, and can be usefully employed to adapt existing buildings for self-feeding.

The fifth and final design provides for an adequate length of manger situated along the outside of the exercise area, and for the storage of straw alongside the littered area. In addition, the right angular arrangement of the two buildings gives much better shelter than the fourth design. Again this is often an excellent method of converting an existing building to meet modern requirements.

By using the methods implicit in these designs, and by attaining the standards suggested, the labour required to tend each cow can be reduced by some 42 man hours a year compared with the average amount that is used in byres. It is important to recognise, however, that at the levels of efficiency suggested as attainable, only a few hours per cow a year are to be saved by replacing a good byre with yards and a parlour:—

Man Hours per Cow a Year

	Attainable Performance		
Number of Cows	15	30	45
Byres	68	57	53
Yards and Parlours	67	53	47
Difference	1	4	6

Where a new herd is to be established, where the herd is housed in a number of small byres in different parts of the steading, or where an existing byre requires substantial renovation, the yard and parlour system should certainly be considered. It is flexible, and more likely to be adaptable to new methods; nor does it require silage and manure to be regularly manhandled in all weathers. Despite these advantages, on farms with a reasonable byre it will be better not to build a new yard and parlour, but to seek increased labour efficiency, and to use the capital that is saved in some more profitable way. For example, in improving the housing of other livestock.

Alternatively, dutch barns, byres and similar buildings may sometimes be easily and cheaply converted into yarding accommodation along the lines suggested. In some cases this will be worthwhile, particularly if it enables more cows to be kept. More frequently, as is the case in the following example, it is better to concentrate on improving work methods than to change systems of housing and milking.

On this North Cumberland farm the byre is of traditional design. It is a long, narrow building containing a single row of standings with a hay loft above. Old stables at one end of the byre have been modified and now provide additional standings at right angles to the main byre. The layout is shown in Figure 6.

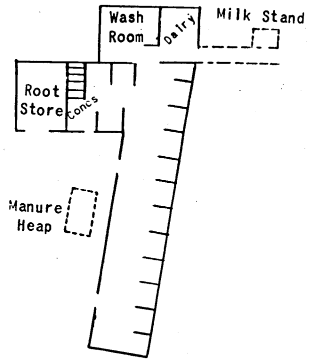


FIGURE 6.

This is not a good layout. Indeed, the work and effort involved in feeding and milking could easily be high. The difficulties have been largely overcome by recognising that movements between work places are unproductive, that in a bad layout they are particularly wasteful of labour, and by therefore adopting methods which reduce these to a minimum.

Three basic principles were applied whenever possible. As few materials as possible were handled. For example, straw was used sparingly, and there was little straw or manure to be removed when the byre was cleaned and littered.

Secondly, feed, litter and manure were each stored conveniently close to the byre. Roots and concentrates needed only to be fetched from a few yards away, hay and straw were stored in the loft, and the manure heap was just outside the byre.

Thirdly, materials were moved in bulk. Milk was tipped into large pails in the byre, and was then bulk handled to the dairy. Concentrates, roots and manure were carried in a trolley, and hay and straw were thrown down from the loft.

There is nothing very novel in these methods, but it is rare to find the three principles underlying good materials handling adhered to so consistently.

As a result one man operated three milking machines, and milked the twenty-eight cow herd in little more than one hour. Feeding, cleaning and littering were very quickly carried out, and all the routine jobs were done before breakfast and in the late afternoon.

The success of these methods is apparent from a comparison between herd labour requirements on this farm and the standards given earlier:—

	Number of Cows	Man Hours per Cow a Year
Average	25	99
This Farm	28	66
Attainable Standard ...	28	61

Tipping the milk into large pails and taking it to the cooler less frequently than is usual was not entirely successful in enabling the cowman to operate three machines, and there was some over milking. For the same reason, and because he did not use a milking trolley, he found that with three machines he had barely enough time to wash the cows' udders and examine the fore milk as thoroughly as he would have liked. A milking trolley, tipping milk to churns in the byre, and in-churn cooling reduced labour requirements by rather more than four man hours per cow a year. Thus labour requirements were reduced almost to the standard of 61 man hours per cow suggested as attainable, the cowman had more time during milking, and was able to thoroughly prepare each cow.

CHAPTER 5

OTHER ENTERPRISES

Very little labour is required to look after the sheep and the few pigs that are kept on these farms, and apart from the dairy herd, the poultry and dairy followers offer more scope for saving labour than any of the other livestock enterprises.

In this investigation methods of organising or re-organising each of these enterprises could not be examined in detail, and in this chapter it is intended only to draw attention to the more important principles and factors influencing their labour requirements.

POULTRY

In all but a few cases less than four hundred hens were kept, and up to this number can be satisfactorily housed on deep litter as a single group. If the work is effectively organised the following standards are then readily attainable:—

Number of Birds	Total Man Hours per Week
100	3.1
200	4.4
300	5.7
400	7.1
500	8.4

On some farms the poultry houses are seriously understocked, small groups of birds are scattered about the available buildings, and feed, litter and eggs are moved in small quantities by hand methods. This is reflected in standards of performance. For example, 227 birds per 100 acres were kept on the average 0—80 acre farms. The labour they used in each half month was 20 man hours per 100 acres as compared with a suggested requirement of 12 or 13 man hours.

On the intensive 0—80 acre farms 549 birds per 100 acres were kept. Average labour use in each half monthly period was 49 man hours per 100 acres as compared with the 23 man hours required under improved circumstances.

On the farms of more than 80 acres poultry tended to be of less importance, and therefore there was little scope for saving labour. In only a few cases were large numbers of poultry kept, and an examination of methods would then be worthwhile.

DAIRY FOLLOWERS

Similar considerations influence the labour required to look after young cattle. Their requirements are reduced by simplifying rations, by reducing the frequency of feeding and littering, by eliminating unnecessary movements between work places, and by planning with a view to keeping necessary activities to a minimum.

Extreme examples of the labour required to tend the 20 followers on the average 0—80 acre farm might be as follows.

On the one hand they may be housed about the steading in five or six loose boxes, they may be given roots, silage, hay and a small quantity of concentrates at each of two feeds, and they may be bedded down with 30 lbs. of straw each every day. Under such circumstances it would not be uncommon for a stockman to walk 150 yards in order to distribute 60 lbs. of material to each beast daily, and to take 14 or 15 hours a week to feed and litter 20 followers.

Alternatively, the same 20 followers might be housed in a well planned yard, self-fed silage, given hay and concentrates once a day, and provided with 20 lbs. of fresh litter per head every other day. The work can then be arranged so that the stockman need only walk 20 yards, and handle 20 lbs. of food and litter a day for each beast. He then requires no more than two or three hours a week to feed and litter 20 beasts:—

Man Minutes per Beast a Week

Feeding

Distance walked daily to feed each beast (yards)	Weight of food distributed daily to each beast (lbs.) 10	20	40	60
15	4	5	7	9
50	11	12	14	16
100	22	23	25	27
150	33	34	36	38

Littering

Distance walked to litter each beast (yards)	Weight of Straw used per Beast (lbs.) Littering Daily				Littering once every two days			
	10	20	30	40	20	40	60	80
5	6	8	9	10	4	5	6	7
15	8	10	11	13	5	6	7	8
50	16	18	19	20	9	10	11	12

On typical farms in each size group 20 or more man hours per 100 acres per half month could be saved in these ways in Winter.

FIELD WORK

The advantage to be obtained from saving labour in the field depends not on reducing the labour of jobs recurring throughout the year, but on saving time on seasonally important jobs.

Silage making was selected as an example. This occurs at one of the busiest times of the year, and farmers need to carry it out quickly and efficiently. Despite this, on the sample farms it was found that on average only 0.7 tons of silage were made in a man hour compared with the two or more tons per man hour which it is possible to make with some of the organisations and methods shown in the table below and in Appendix 8.

Silage Making with a Forage Harvester — *Tons per Hour and Per Man Hour*

Distance between field and clamp in yards	290		390		430	
Method	Per Man Hour	Per Hour	Per Man Hour	Per Hour	Per Man Hour	Per Hour
1. 1 man cutting and loading 1 man carting to pit and spreading Rolling done before and after cutting (2 men, 2 Tractors, 2 Trailers, 1 Harvester)	1.8	3.4	1.7	3.2	1.6	3.1
2. 1 man cutting, loading and carting 1 man spreading and rolling (2 men, 2 Tractors, 1 Trailer, 1 Harvester)	1.5	3.1	1.5	2.9	1.4	2.8
3. 1 man cutting and loading 1 man carting to clamp 1 man spreading Rolling done before and after cutting (3 men, 2 Tractors, 2 Trailers, 1 Harvester)	1.9	5.4	1.9	5.4	1.9	5.4
4. 1 man cutting, loading, carting and spreading Rolling done before and after cutting (1 man, 1 Tractor, 1 Trailer, 1 Harvester)	2.0	2.0	1.9	1.9	1.9	1.9
5. 1 man cutting and loading 1 man carting to by clamp, hitching & unhitching 1 man buckraking onto clamp and spreading (3 men, 3 Tractors, 2 Trailers, 1 Buckrake, 1 Harvester)	2.2	6.6	2.0	6.0	1.9	5.7
6. 1 man cutting, loading and hitching 1 man carting and hitching 1 man buckraking onto clamp and spreading (3 men, 3 Tractors, 2 Trailers, 1 Buckrake, 1 Harvester)	2.0	6.1	2.0	6.1	2.0	6.1

The performances in the table relate to three transport distances. The middle distance is that which silage was observed to be transported on average, and the shorter and longer hauls are the average distances that silage was buckraked and carted respectively. They assume that a tractor of sufficient horse power to pull the harvester is used, that optimum performance is obtained from it, and that 25 cwt. loads are taken to the clamp in well designed, rear tipping trailers.

At each of these distances between field and clamp one man equipped with a tractor and two trailers, together with a second man buckraking tipped silage onto the clamp, can keep a third man fully occupied operating a small forage harvester. With the short haul it is the speed of cutting and loading which limits output, and if 6.6 tons of silage an hour are to be made most of the hitching and unhitching must be done by the trailer driver. At greater distances than these between the field and the clamp output is limited by the transport available, and if the forage harvester is to be fully utilised a man with an extra tractor and trailer must be added to the team. Otherwise, the balance of the team is likely to be at its best if the harvester and trailer drivers share the work of hitching and unhitching. Over six tons of silage an hour can then be made despite the greater distance between field and clamp.

If rolling is carried out before and after a period of cutting and carting, and if it is more important to obtain a high output per man than a high output per day, almost the same output per man hour can be obtained using one less tractor. With only two tractors, however, it is advisable to make arrangements for winching the transport tractor off the clamp should it get stuck.

With each of these organisations it is possible to obtain both a high output per man and a high output per day, but each requires too much equipment to be of very much use on the smaller farm unless neighbouring farmers are prepared to co-operate.

Of the methods requiring less equipment one man equipped with a small forage harvester and a suitable 25 cwt. rear tipping trailer can make about two tons of silage an hour if the clamp is not more than 300 or 400 yards away. This compares very favourably with the performance to be expected from organisations employing two men, although the number of tons of silage that will be made each hour is, of course, less than when a second man is employed.

It may be of more importance to appreciate that the smaller forage harvester only offers obvious advantages if silage has to be transported a long distance, where a large amount of silage is to be made and the amount got per hour is as important as productivity per man hour, or where labour capable of really skilled buckraking is not available.

The performances to be expected from a skilled man equipped with a tractor and a rear-mounted buckrake are given in the table below and in Appendix 8.

Method 7 Buckraking	Time in Minutes		
Distance between field and clamp (yards)	290	390	430
To field	1.53	2.02	2.26
Turn, back to swathes and lower rake	0.23	0.23	0.23
Pick up a 6 to 7 cwt. load	1.25	1.25	1.25
To silo	2.46	3.24	3.64
Drive onto clamp, drop load and drive off silo	0.41	0.41	0.41
Spread load on silo	1.06	1.06	1.06
Work cycle (minutes)	6.94	8.21	8.85
Mowing per load	1.78	1.78	1.78
Rolling per load	0.44	0.44	0.44
Contingencies and Relaxation Allowance	1.02	1.16	1.23
Total (6.7 cwts.)	10.18	11.59	12.30
Tons per Man Hour	2.00	1.70	1.60

On the small farm where the fields and clamp are not far apart such a man can make up to two tons of silage an hour, or much the same amount as a man using a small forage harvester. With an increasing distance between the fields and the clamp his performance falls off faster than that of a man using a harvester and a trailer because he carries a smaller load. He can, however, still make 1.7 tons of silage an hour when the silage is carted 390 yards, the average observed distance on the sample farms.

If the extra depreciation on a harvester is considered, and if it is accepted that implements such as these should be written off in five years, it appears that even when the field and the clamp are seven or eight hundred yards apart a large acreage of silage must be made before it can be produced more cheaply with a harvester and trailer than with a buckrake.

ESTIMATED COSTS ASSUMING AN 8 TON CROP, AND AN AVERAGE DISTANCE OF 800 YARDS BETWEEN THE FIELDS AND THE CLAMP

	£	£
1. *Forage Harvesting*		
Fixed Costs:—		
Depreciation @ 20% over 5 years	50	
Interest @ 5% on the average investment	6	
		56
Variable Costs per 100 acres:—		
Repairs	13	
Labour, 500 hours @ 4/- an hour	100	
Tractor fuel and repairs, 500 hours @ 2/6 an hour	62	
		175
Total Cost per 100 acres		£231
2. *Buckraking*		
Fixed Costs:—		
Interest @ 5% and Depreciation @ 20% over 5 years ...		9
Variable Costs per 100 acres:—		
Repairs	4	
Labour, 727 hours @ 4/- an hour	145	
Tractor fuel and repairs, 727 hours @ 2/6 an hour	91	
		240
Total Cost per 100 acres		£249
	£	
Difference in Costs per 100 acres	18	
Difference in Variable Costs per 100 acres	65	
Difference in Variable Costs required to equalise the costs of the two methods	47	

Acreage of Silage required for Equal Costs $= 100 \times \frac{47}{65} = 72.$

This calculation assumes that a tipping trailer is available and does not have to be specially purchased for silage making, and that a tractor of sufficient power to pull a harvester is used either for forage harvesting or buckraking. Although these assumptions may rarely be true their purpose is to compare the two methods under circumstances favourable to a forage harvester. Under less favourable circumstances, with a smaller acreage than this or a shorter distance between the field and the clamp, buckraking is potentially the cheaper of the two methods.

The small forage harvester should not then be regarded as a means of reducing the costs of making silage on either small or medium sized farms where there are perhaps one or two trailers, rather as a means of making more silage in the limited time available. Only when the average distance between the fields and the clamp is considerable, and when a sufficient number of trailers are available to keep it fairly fully employed is it likely that a forage harvester will offer greater opportunities of reducing the cost of silage making than skilled buckraking. With either method the aim should be to make at least 1.7 tons of silage per man hour as compared with the observed average output of 0.7 tons per man hour.

CONCLUSIONS

It is suggested that the more traditional ways of saving labour offer limited scope on small and medium sized farms of this type, and that to be effective they must usually be accompanied by stocking and policy changes affecting the economy of the whole farm.

In contrast the systematic improvement of work methods appears to offer many opportunities of reducing costs, particularly if attention is directed to the regular livestock jobs and seasonally important field work. In this way labour can often be saved without heavy expenditure on new buildings and machines. All that is necessary is to make the most of the equipment available.

Of the many opportunities it has only been possible to examine those that appeared likely to be the most important, and it has been shown that substantial savings could be obtained.

Labour requirements vary annually, seasonally, and from farm to farm. Nor is the seasonal distribution of requirements fixed, for there is the opportunity of doing some jobs either sooner or later in the year. The variation in labour requirements is reduced rather than increased when work methods are improved. Thus both total and seasonal requirements should be adequately met if labour is in no shorter supply in the critical Spring and June periods than it is now on premium farms. Using this criterion of requirements estimates of the labour that could be saved in the ways described are given in Appendix 9. They vary from 3,600 man hours per 100 acres a year on average 0—80 acre farms to 1,500 or 1,600 man hours per 100 acres on the more intensive 121—200 acre farms.

Wages have increased in the meantime, but even in 1956/7 savings of this magnitude might have reduced costs substantially:—

Labour Costs per Acre

Size Group	0—80 acres		81—120 acres		121—200 acres	
Intensity	Average	High	Average	High	Average	High
	£	£	£	£	£	£
Actual Labour Costs:—						
Farmer and Wife	7.9	6.4	4.1	4.2	2.6	3.3
Other regular labour	4.8	6.3	5.6	6.0	6.4	7.6
Casual	0.6	0.8	0.3	0.1	0.5	0.7
TOTAL	13.3	13.5	10.0	10.3	9.5	11.6
Attainable Requirements:—						
Farmer, wife and other regular labour	7.2	8.5	6.4	6.0	6.0	8.4
Casual	0.4	0.3	0.3	0.2	0.5	0.7
TOTAL	7.6	8.8	6.7	6.2	6.5	9.1
POTENTIAL SAVING	5.7	4.7	3.3	4.1	3.0	2.5

In any particular case, of course, the extent to which such savings would be effective depends on the success with which the labour supply could be adjusted to new requirements. In some cases a man could be dispensed with, in far more, intensification would enable existing labour to be more productive. Alternatively, on the small farm the farmer may wish to save labour so that he and his family may have more leisure, and more time in which to plan and to manage the business.

APPENDIX 1

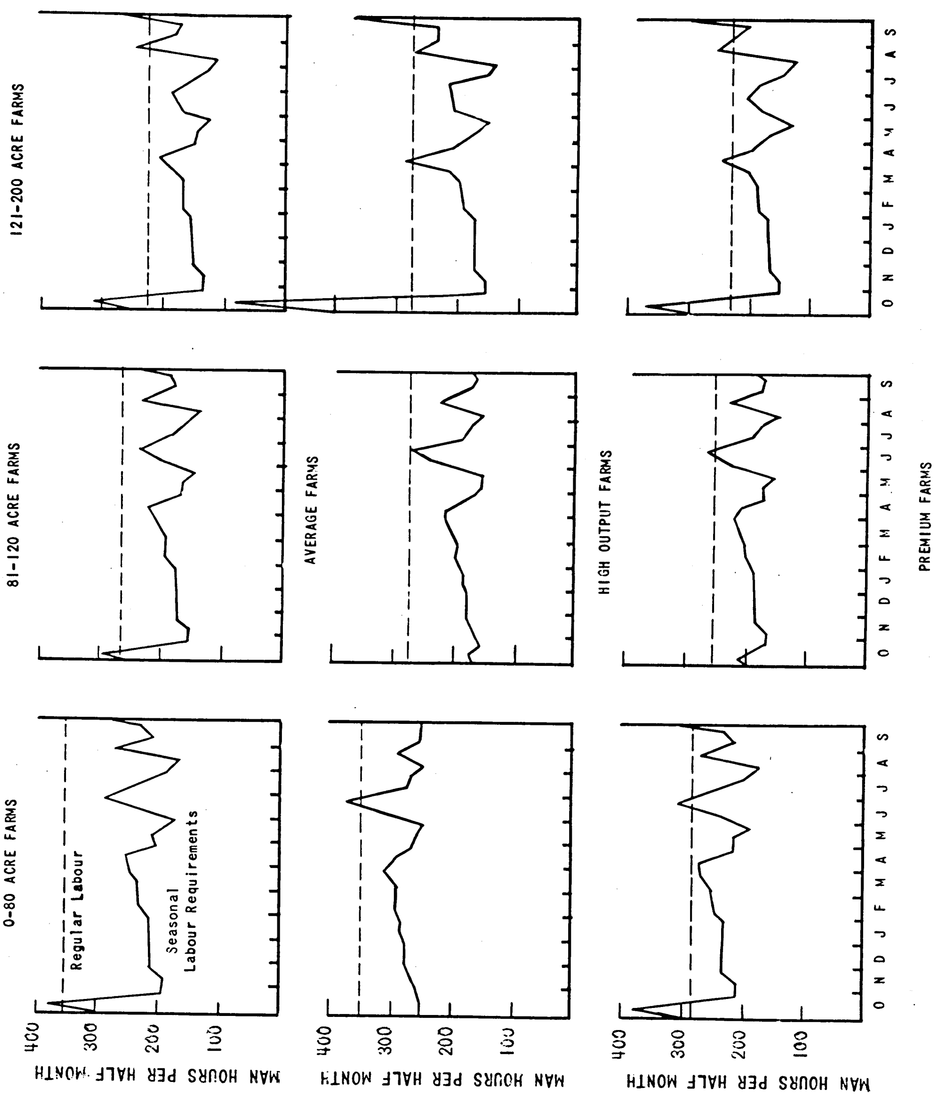
Outputs and Costs 1956/7

Farm Size	0—80 acres			81—120 acres			121—200 acres		
Intensity	Avge.	Prem.	High	Avge.	Prem.	High	Avge.	Prem	High
	£	£	£	£	£	£	£	£	£
GROSS OUTPUT PER ACRE									
Cattle	5.6	6.4	6.9	6.1	8.0	6.9	4.3	5.6	5.6
Milk	30.3	35.4	43.4	26.1	31.7	34.2	21.9	31.2	29.2
Sheep and Wool	1.5	2.3	2.3	3.0	4.0	4.4	2.3	1.4	2.6
Pigs	1.4	1.7	8.2	1.9	4.7	4.8	0.9	0.3	0.3
Poultry and Eggs	4.7	6.2	10.9	2.7	2.9	2.6	1.6	1.3	2.6
Crops	2.5	2.5	0.3	2.5	1.6	1.9	4.6	4.9	7.4
Miscellaneous	2.0	2.3	3.7	2.0	2.3	2.7	1.9	2.9	2.9
Total	48.0	56.8	75.7	44.3	55.2	57.5	37.5	47.6	50.6
COSTS PER ACRE									
Labour	5.4	2.8	7.1	5.9	5.4	6.1	6.9	6.6	8.3
Feedingstuffs	16.8	21.1	36.8	12.6	18.5	19.5	8.7	11.8	12.1
Seeds	0.8	0.7	0.7	0.7	0.7	0.7	1.1	1.4	1.6
Fertilizers	2.2	2.0	2.8	2.0	2.4	2.9	2.3	2.2	3.3
Rent and Rates	2.6	2.8	3.0	2.9	3.0	3.0	2.6	2.7	2.9
Machinery and Power	7.8	8.4	9.3	7.6	7.9	8.7	6.1	6.2	5.9
Miscellaneous	2.1	1.7	5.0	2.2	2.3	3.7	1.5	1.8	2.4
Total	37.7	39.5	64.7	33.9	40.2	44.6	29.2	32.7	36.5
NET FARM INCOME	10.3	17.3	11.0	10.4	15.0	12.9	8.3	14.9	14.1
Farmer and Wife labour	7.9	8.2	6.4	4.1	4.6	4.2	2.6	3.0	3.3
MANAGEMENT AND INVESTMENT INCOME	2.4	9.1	4.6	6.3	10.4	8.7	5.7	11.9	10.8

Stocking and Cropping per 100 acres 1956/7

Farm Size	0—80 acres			81—120 acres			121—200 acres		
Intensity	Avge.	Prem.	High	Avge.	Prem.	High	Avge.	Prem.	High
STOCKING									
Horses	1.0	1.1	—	0.4	—	—	0.4	0.3	0.3
Bulls	0.6	0.8	—	0.8	0.9	0.7	0.6	0.7	0.6
Cows	28.1	29.0	32.8	23.5	26.8	26.9	19.4	26.0	25.0
Other Cattle	32.1	37.0	28.8	30.5	30.6	31.0	26.9	27.6	26.8
Ewes	12.1	21.1	19.1	20.7	27.6	30.2	18.5	9.4	9.3
Rams	0.5	1.0	0.9	0.8	1.1	1.1	0.4	0.3	0.2
Other sheep over 6 mths.	10.8	—	10.9	9.7	13.2	3.9	7.9	—	6.4
Store sheep bought for fattening	—	—	—	8.0	0.6	—	14.4	27.5	21.2
Sows and in pig gilts	1.1	1.1	3.7	0.9	1.4	1.7	0.6	0.3	0.1
Boars	—	—	0.2	0.1	—	—	—	—	—
Other Pigs over 2 months	1.6	4.3	20.8	3.0	3.5	4.2	3.1	1.5	0.8
Fat Pigs Sold	2.5	1.6	35.7	11.2	30.3	28.1	6.3	2.4	2.2
Poultry over 6 months	227.0	254.6	549.0	104.5	88.7	46.0	89.2	94.8	131.2
Poultry under 6 months	124.5	151.7	344.0	78.4	46.4	29.1	38.8	36.8	63.5
CROPPING									
Wheat	1.2	—	—	0.7	—	—	2.6	—	—
Barley	—	—	—	0.2	—	—	2.8	6.4	6.5
Oats and Mixed Corn	13.7	14.6	5.8	12.3	8.7	8.0	12.9	13.9	13.8
Potatoes	2.8	2.8	—	2.1	0.7	0.3	2.6	3.3	6.1
Kale	1.5	0.2	3.4	2.3	3.5	2.9	2.2	0.8	1.1
Feed Roots	4.3	4.3	2.0	2.2	2.5	1.2	2.3	2.7	2.2
Hay	29.6	36.1	32.6	25.8	28.7	32.6	17.2	18.1	15.8
Silage	3.5	—	7.7	9.9	12.4	16.8	10.0	3.5	11.6
Grazing	43.4	42.0	48.5	44.5	43.5	38.2	46.6	51.3	42.9

APPENDIX 2



APPENDIX 2. Average Labour Requirements and Regular Labour Available per 100 acres.

APPENDIX 3

Milking in Single and Double Row Byres with standings for 15 to 45 Cows

1. Using a Surface Milk Cooler

DISTANCE IN FEET	OPERATION	TIME IN MINUTES
	LONG CYCLE	
8	To cow	.03
	Wash udder and examine fore milk	.50
16	To previous cow	.07
	Machine strip and machine off	.33
	Disconnect machine and pick up unit	.08
8	To centre or back	.03
	Change buckets	.08
8	To cow previously washed	.03
	Connect machine, position cluster and put machine on cow	.28
8	To centre or back	.03
32—164	Take milk to cooler and return:—	

Number of cows	Single Row	Double Row	
15	0.35	0.27	
30	0.50	0.33	.27—.66
45	0.66	0.43	

DISTANCE IN FEET	OPERATION	TIME IN MINUTES
	SHORT CYCLE	
6	To cow	.02
	Wash udder and examine fore milk	.50
	Machine strip adjacent cow and machine off	.33
	Change buckets, position cluster and put machine on cow	.28
	To centre or back	.02
32—164	Milk to cooler and return	.27—.66
	ROUTINE TIME—Long Cycle	1.73—2.12
	Short Cycle	1.42—1.81
	Average	1.58—1.97

2. Using a Milking Trolley and In-Churn Cooling

DISTANCE IN FEET	OPERATION	TIME IN MINUTES
	LONG CYCLE	
8	From churn to cow	.03
	Wash udder and examine fore milk	.50
16	To previous cow	.07
	Machine strip and machine off	.33
	Disconnect machine and pick up unit	.08
8	To trolley	.03
	Change buckets	.08
8	To cow previously washed	.03
	Connect machine, position cluster and put machine on cow	.28
8	To trolley	.03
	Tip milk to churn	.08
	Move trolley	.03
	SHORT CYCLE	
8	From churn to cow	.03
	Wash udder and examine fore milk	.50
	Machine strip adjacent cow and machine off	.33
	Change buckets, position cluster and put machine on cow	.28
8	To trolley	.03
	Tip milk to churn	.08
	ROUTINE TIME—Long Cycle	1.57
	Short Cycle	1.25
	Average	1.41

Required "Machine on Time" in minutes per cow for different average yields in lbs.

Approx. Annual Av. (gals.)	A.M. Yield	Machine on Time	P.M. Yield	Machine on Time
700	13	4.46	11	4.13
800	15	4.79	12	4.30
900	17	5.12	14	4.63
1000	19	5.45	15	4.79

APPENDIX 4

Examples of attainable rates of milking in Single and Double Row Byres for up to 45 cows

EXAMPLE 1. Fifteen cows are milked in a small double row byre and average about 700 gallons of milk a year. The milk is cooled over a surface cooler.

		Minutes
Average machine on time per cow	A.M.	4.46
	P.M.	4.13
Average machine off time per cow		0.39
Average man routine time per cow		1.58

Optimum Number of Machines

$$\text{A.M.} = \frac{4.46+0.39}{1.58} = 3 \text{ \& } 0.11 \text{ minutes for eventualities}$$

$$\text{P.M.} = \frac{4.13+0.39}{1.58} = 2 \text{ \& } 1.36 \text{ minutes for eventualities}$$

Attainable Rate of Milking

$$\text{A.M.} = \frac{3}{4.46+0.39} \times 60 = 37 \text{ cows a man hour}$$

$$\text{P.M.} = \frac{2}{4.13+0.39} \times 60 = 27 \text{ cows a man hour}$$

EXAMPLE 2. Fifteen cows are milked in the same double row byre, but they average about 1,000 gallons of milk a year. The milk is again cooled over a surface cooler.

		Minutes
Average machine on time per cow	A.M.	5.45
	P.M.	4.79
Average machine off time per cow		0.39
Average man routine time per cow		1.58

Optimum Number of Machines

$$\text{A.M.} = \frac{5.45+0.39}{1.58} = 3 \text{ \& } 1.10 \text{ minutes for eventualities}$$

$$\text{P.M.} = \frac{4.79+0.39}{1.58} = 3 \text{ \& } 0.44 \text{ minutes for eventualities}$$

Attainable Rate of Milking

$$\text{A.M.} = \frac{3}{5.45+0.39} \times 60 = 31 \text{ cows a man hour}$$

$$\text{P.M.} = \frac{3}{4.79+0.39} \times 60 = 35 \text{ cows a man hour}$$

EXAMPLE 3. Any number of cows milked in a single or double row byre and averaging about 700 gallons of milk a year, the milk being tipped to churns in the byre and in-churn cooled.

		Minutes
Average machine on time per cow	A.M.	4.46
	P.M.	4.13
Average machine off time per cow		0.39
Average man routine time per cow		1.41

Optimum Number of Machine

$$\text{A.M.} = \frac{4.46+0.39}{1.41} = 3 \text{ \& } 0.62 \text{ minutes for eventualities}$$

$$\text{P.M.} = \frac{4.13+0.39}{1.41} = 3 \text{ \& } 0.29 \text{ minutes for eventualities}$$

Attainable Rate of Milking

$$\text{A.M.} = \frac{3}{4.46+0.39} \times 60 = 37 \text{ cows a man hour}$$

$$\text{P.M.} = \frac{3}{4.13+0.39} \times 60 = 40 \text{ cows a man hour}$$

APPENDIX 5

Dairy Work

EXAMPLE 1. Three units are used to milk the cows, and the milk is cooled over a surface cooler.

JOB	Number of Cows	MINUTES 15	30	45
Preparation of Equipment	Assemble surface cooler, re-assemble 3 milking machines, fetch pairs of empty churns from outside dairy, prepare udder wash, put equipment on milking trolley and push into byre. A.M.	5.30	5.52	5.83
	P.M.	5.30	5.52	5.83
Washing up	Put equipment on trolley and push into dairy. Part dismantle, wash and aside 3 milking machines, wash and aside spare milking bucket and strip cup, rinse pails, dismantle cooler, wash and aside cooler parts, swill dairy floor. A.M.	11.13	11.25	11.37
	P.M.	11.13	11.25	11.37
	Allowance for periodic stripping down and cleaning of milking machines	3.20	3.20	3.20
Handling milk	Check and adjust milk levels in churns, replace lids, label churns, move to outside dairy and lift onto milk stand.	4.57	9.15	13.72
	(Average additional time required if milk stand at farm gate).	7.37	8.57	9.83
Total	(a) Milk stand outside Dairy	40.63	45.89	51.32
	(b) Milk stand by Farm Gate	48.00	54.46	61.15
Man hours per per week	(a)	4.7	5.4	6.0
	(b)	5.6	6.4	7.1
Man hours per Cow per week	(a)	0.31	0.18	0.13
	(b)	0.37	0.21	0.16

EXAMPLE 2. Three units are used to milk the cows, and the milk is in-churn cooled.

JOB	Number of Cows	MINUTES 15	30	45
Preparation of Equipment	Re-assemble 3 milking machines, fetch pairs of empty churns from outside dairy, prepare udder wash, put equipment on milking trolley and push into byre. A.M.	3.37	3.58	3.80
	P.M.	3.37	3.58	3.80
Washing up	Put equipment on trolley and push into dairy. Part dismantle wash and aside 3 milking machines, wash and aside spare milking bucket and strip cup, rinse pails, wash cooling heads, swill dairy floor. A.M.	8.70	9.32	9.93
	P.M.	8.70	9.32	9.93
	Allowance for periodic stripping down and cleaning of machines.	3.20	3.20	3.20
Handling Milk	Check and adjust milk levels in churns, replace lids, label churns, move to outside dairy and lift onto milk stand.	4.57	9.15	13.72
	(Average additional time required if milk stand at farm gate).	7.37	8.57	9.83
Total	(a) Milk Stand outside Dairy	31.91	38.15	44.38
	(b) Milk Stand by Farm Gate	39.28	46.72	54.21
Man hours per week	(a)	3.7	4.5	5.2
	(b)	4.6	5.5	6.3
Man hours per Cow per week	(a)	0.25	0.15	0.12
	(b)	0.31	0.18	0.14

APPENDIX 6

Methods of Feeding

○ Operation
⇨ Transport
D Delay
□ Inspection
▽ Storage
—— Repeat the previous bracketed activities.

Method 1. Roots are stored and sliced outside the centre door of the byre. They are distributed 40 lbs. at a time in a skip. Hay which is stored on the other side of the byre is also close at hand.

Activity — Number of cows	MINUTES 15	30	45
To root store	.10	.13	.15
Start motor of slicer	.17	.17	.17
To roots with skip	.03	.03	.03
Fill skip with 40 lbs roots	.30	.30	.30
To slicer	.03	.03	.03
Tip roots to slicer	.17	.17	.17
Wait for slicer to cut roots	.18	.18	.18
Remove full skip and place empty skip under slicer	.08	.08	.08
Carry full skip into byre	.12	.15	.18
Feed roots to 1 cow	.05	.05	.05
Feed roots to second cow	.05	.05	.05
To roots or slicer	.10	.13	.15
Repeat 6, 14 or 21 more times	6.48	15.96	24.99
Fill skip with 20 lbs roots	.15	—	.15
To slicer	.03	—	.03
Tip roots to slicer	.08	—	.08
Wait for slicer to cut roots	.10	—	.10
Remove half full skip and place empty skip under slicer	.08	—	.08
Carry half full skip into byre	.12	—	.18
Feed roots to one cow	.05	—	.05
To slicer with empty skip	.10	—	.15
Stop motor	.08	.08	.08
To byre	.10	.13	.15
To barn	.13	.15	.18
Climb onto stack	.15	.15	.15
Select and throw 1 bale to ground	.17	.17	.17
Repeat 1 or 2, 4 or 7 more times	.26	.68	1.19
Climb off stack	.15	.15	.15
Pick up bale	.08	.08	.08
Carry into byre	.18	.21	.25
Drop bale onto floor, cut and aside strings	.10	.10	.10
Pick up half of bale	.08	.08	.08
To cow and feed hay	.08	.08	.08
To next cow and feed hay	.05	.05	.05
To next cow and feed hay	.05	.05	.05
To remainder of bale	.05	.05	.05
Pick up half of bale	.08	.08	.08
To cow and feed hay	.08	.08	.08
To next cow and feed hay	.05	.05	.05
To next cow and feed hay	.05	.05	.05
To barn	.13	.15	.18
Repeat 1, 4 or 6 times	1.06	4.29	7.08
Cut and aside string of last bale (once every 2 feeds average time)	.05	—	.05
Pick up half of bale	.08	—	.08

Activity / Number of Cows	MINUTES 15	30	45
Carry into byre	.18	—	.25
To cow and feed hay	.08	—	.08
To next cow and feed hay	.05	—	.05
To next cow and feed hay	.05	—	.05
	12.22	24.34	38.24
Daily Total	24.44	48.68	76.48
Man Hours per Week	2.85	5.68	8.92
Man Hours per Cow per Week	0.19	0.19	0.20

Method 2. Roots are stored several feet above ground level, gravity fed into the slicer, and allowed to fall into a low trolley for distribution. Hay is also taken into the byre on a trolley.

Activity / Number of Cows	MINUTES 15	30	45
To root store A.M.	.10	.13	.15
Start motor of slicer	.17	.17	.17
To roots	.03	.03	.03
Put 300 lbs of roots onto gravity conveyor	2.25	2.25	2.25
To slicer	.03	.03	.03
Push full trolley into byre	.20	.26	.30
Fill skip with 40 lbs of roots	.30	.30	.30
To cow and feed roots	.05	.05	.05
To next cow and feed roots	.05	.05	.05
To trolley	.05	.05	.05
Repeat 1 more time	.45	.45	.45
Move trolley	.08	.08	.08
Repeat 2 more times	1.96	1.96	1.96
Fill skip with 40 lbs roots	.30	.30	.30
To cow and feed roots	.05	.05	.05
To next cow and feed roots	.05	.05	.05
To trolley	.05	.05	.05
Fill skip with 20 lbs of roots	.15	.15	.15
To cow and feed roots	.05	.05	.05
To trolley	.05	.05	.05
Push empty trolley to slicer	.20	.26	.30
Repeat 0, 1 or 2 more times	—	6.47	13.10
Stop motor	.08	.08	.08
To byre	.10	.13	.15
All repeated P.M.	6.80	13.45	20.20

To trolley A.M.	.09	.09	.14
Push empty hay trolley to barn	.26	.30	.36
Climb onto stack	.15	.15	.15
Select and throw 1 bale to ground	.17	.17	.17
Repeat 4, 9 or 14 times	.68	1.53	2.38
Climb off stack	.15	.15	.15
Put 1 bale on trolley	.08	.08	.08
Repeat 2, 4 or 7 more times	.16	.32	.56
Push full trolley into byre	.26	.30	.36
Cut and aside bale strings	.10	.10	.10
Pick up half of bale	.08	.08	.08
To cow and feed hay	.08	.08	.08

Activity	Number of Cows	15	30	45
		MINUTES		
	To next cow and feed hay	.05	.05	.05
	To next cow and feed hay	.05	.05	.05
	To trolley	.08	.08	.08
	Repeat 1 more time	.34	.34	.34
	Move trolley or move trolley to back	.07	.07	.07
	Repeat 1, 4 or 6 more times	.85	3.40	5.10
	Cut and aside bale strings	.10	—	.10
	Pick up half of bale	.08	—	.08
	To cow and feed hay	.08	—	.08
	To next cow and feed hay	.05	—	.05
	To next cow and feed hay	.05	—	.05
	To trolley	.08	—	.08
	Move trolley to back	.07	—	.07

	To trolley P.M.	.09	.09	.14
	Push empty hay trolley to barn	.26	.30	.36
	Put bale on trolley	.08	.08	.08
	Repeat 1, 4 or 6 more times	.08	.32	.48
	Push full trolley into byre	.26	.30	.36
	Cut and aside bale strings	.10	.10	.10
	Pick up half of bale	.08	.08	.08
	To cow and feed hay	.08	.08	.08
	To next cow and feed hay	.05	.05	.05
	To next cow and feed hay	.05	.05	.05
	To trolley	.08	.08	.08
	Repeat 1 more time	.34	.34	.34
	Move trolley, or move trolley to back	.07	.07	.07
	Repeat 1, 4 or 6 more times	.85	3.40	5.10
	Pick up half of bale left from A.M.	.08	—	.08
	To cow and feed hay	.08	—	.08
	To next cow and feed hay	.05	—	.05
	To next cow and feed hay	.05	—	.05
	Move trolley to back	.07	—	.07
	Daily Total	20.61	39.58	58.91
	Man Hours per Week	2.40	4.62	6.87
	Man Hours per Cow per Week	0.16	0.15	0.15

Method 3. Silage which is clamped at a convenient distance from the byre is distributed on a trolley. Hay is fed by the previous method.

Activity	Number of Cows	15	30	45
		MINUTES		
	To trolley A.M.	.09	.09	.14
	Push empty trolley to silage clamp	.16	.20	.25
	Pick up knife	.03	.03	.03
	Sharpen knife	1.08	1.08	1.08
	Cut enough silage for 2 feeds	3.00	6.00	9.00
	Aside knife	.03	.03	.03
	Pick up fork	.03	.03	.03
	Fork 300 lbs of silage onto trolley	3.25	3.25	3.25
	Aside fork	.03	.03	.03
	Push full trolley into byre	.16	.20	.25

Activity	Number of Cows	MINUTES 15	30	45
Pick up fork		.03	.03	.03
Fork silage to cow		.10	.10	.10
To trolley		.05	.05	.05
Repeat 1 more time		.15	.15	.15
Aside fork		.03	.03	.03
Move trolley		.05	.05	.05
Repeat 6 more times		2.46	2.46	2.46
Pick up fork		.03	.03	.03
Fork silage to cow		.10	.10	.10
To trolley		.05	.05	.05
Aside fork		.03	.03	.03
Move trolley to back or to silage clamp		.07	.20	.25
Repeat 0, 1 or 2 more times		—	6.66	13.60
To trolley P.M.		.09	.09	.14
Push empty trolley to silage clamp		.16	.20	.25
Pick up fork		.03	.03	.03
Fork 300 lbs silage onto trolley		3.25	3.25	3.25
Aside fork		.03	.03	.03
Push full trolley into byre		.16	.20	.25
Pick up fork		.03	.03	.03
Fork silage to cow		.10	.10	.10
To trolley		.05	.05	.05
Repeat 1 more time		.15	.15	.15
Aside fork		.03	.03	.03
Move trolley		.05	.05	.05
Repeat 6 more times		2.46	2.46	2.46
Pick up fork		.03	.03	.03
Fork silage to cow		.10	.10	.10
To trolley		.05	.05	.05
Aside fork		.03	.03	.03
Move trolley to back or to silage clamp		.07	.20	.25
Repeat 0, 1 or 2 more times		—	6.66	13.60
To trolley A.M.		.09	.09	.14
Push empty hay trolley to barn		.26	.30	.36
Climb onto stack		.15	.15	.15
Select and throw 1 bale to ground		.17	.17	.17
Repeat 1 or 2, 4 or 7 more times		.26	.68	1.19
Climb off stack		.15	.15	.15
Put 1 bale on trolley		.08	.08	.08
Repeat 1 or 2, 4 or 7 more times		.12	.32	.56
Push full trolley into byre		.26	.30	.36
Cut and aside bale strings		.10	.10	.10
Pick up half of bale		.08	.08	.08
To cow and feed hay		.08	.08	.08
To next cow and feed hay		.05	.05	.05
Repeat 4 more times		.20	.20	.20
To trolley		.08	.08	.08
Move trolley		.07	.07	.07

Activity / Number of Cows	MINUTES 15	30	45
Repeat 1 more time	.56	.56	.56
Repeat 0, 1 or 2 more times	—	1.22	2.44
Cut and aside bale strings	.10	.10	.10
Pick up part of bale	.08	.08	.08
To cow and feed hay	.08	.08	.08
To next cow and feed hay	.05	.05	.05
Repeat 1, 4 or 7 more times	.05	.20	.35
To trolley	.08	.08	.08
Move trolley to back	.07	.07	.07
To trolley P.M.	.09	.09	.14
Push trolley to by first cow	.07	.07	.07
Cut and aside bale strings	.10	.10	.10
Pick up half of bale	.08	.08	.08
To cow and feed hay	.08	.08	.08
To next cow and feed hay	.05	.05	.05
Repeat 4 more times	.20	.20	.20
To trolley	.08	.08	.08
Move trolley	.07	.07	.07
Repeat 1 more time	.56	.56	.56
Repeat 0, 1 or 2 more times	—	1.22	2.44
Pick up part of bale	.08	.08	.08
To cow and feed hay	.08	.08	.08
To next cow and feed hay	.05	.05	.05
Repeat 1, 4 or 7 more times	.05	.20	.35
To trolley	.08	.08	.08
Move trolley to back	.07	.07	.07
Daily Totals	22.94	43.12	64.11
Man Hours per Week	2.68	5.03	7.48
Man Hours per cow per Week	0.18	0.17	0.17

APPENDIX 7

Cleaning Out and Littering

The manure heap is presumed to be to one side of an end door of the byre, and at a suitable distance from it. Straw is stored in the dutch barn close at hand.

Activity / Number of Cows	MINUTES 15	30	45
To manure heap ...	.14	.14	.19
Push empty barrow into byre ...	.17	.17	.24
Pick up brush ...	.03	.03	0.3
Brush manure to heap and aside brush ...	.77	.77	.77
Pick up shovel ...	.03	.03	.03
Shovel manure to barrow and aside shovel ...	.82	.82	.82
Move barrow ...	.08	.08	.08
Repeat 1 more time ...	1.73	1.73	1.73
Pick up brush ...	.03	.03	.03
Brush manure to heap and aside brush ...	.77	.77	.77
Pick up shovel ...	.03	.03	.03
Shovel manure to barrow and aside shovel ...	.82	.82	.82
Push full barrow to manure heap ...	.19	.19	.26
Tip manure onto heap ...	.08	.08	.08
Repeat 0, 1 or 3 more times ...	—	5.55	17.07
Push empty barrow into byre ...	.17	.17	—
Pick up brush ...	.03	.03	—
Brush manure to heap and aside brush ...	.77	.77	—
Pick up shovel ...	.03	.03	—
Shovel manure to barrow and aside shovel ...	.82	.82	—
Push partly full barrow to heap or move barrow ...	.18	.08	—
Repeat 1 more time with 30 cows ...	—	1.83	—
Tip manure onto heap ...	.08	.08	—
Return to byre ...	.14	.14	.19
Swill floor with pail of water from tank in byre ...	1.75	2.50	3.75
Brush down byre and passageway after swilling ...	4.50	7.50	11.25
To drains outside byre ...	.05	.05	.05
Clear drains ...	.32	.32	.32
Return to byre ...	.11	.11	.16
To trolley A.M ...	.09	.09	.14
Push empty trolley to barn ...	.26	.30	.36
Climb onto stack ...	.15	.15	.15
Select and throw 1 bale to ground ...	.17	.17	.17
Repeat 2, 5 or 8 more times ...	.34	.85	1.31
Climb off stack ...	.15	.15	.15
Put 1 bale onto trolley ...	.08	.08	.08
Repeat 2, 5 or 8 more times ...	.16	.40	.64
Push full trolley into byre ...	.26	.30	.36
Cut and aside bale strings ...	.10	.10	.10
Pick up fork ...	.03	.03	.03
Litter 5 cows ...	.84	.84	.84
Aside fork ...	.03	.03	.03
Move trolley, or move trolley to back ...	.07	.07	.07
Repeat 2, 5 or 8 more times ...	2.14	5.35	8.56
Fetch fork and walk to 1st Standing P.M. ...	.18	.18	.28
Fork soiled litter off standing into channel and shake up bedding ...	.08	.08	.08
Repeat 14, 29 or 44 more times ...	1.12	2.32	3.52
Aside fork ...	.03	.03	.03
Daily Total ...	20.92	37.19	55.57
Man Hours per Week ...	2.44	4.34	6.48
Man Hours per Cow per Week ...	0.16	0.14	0.14

APPENDIX 8

Silage Making by Selected Methods

Method 1. 1 man cutting and loading with a small forage harvester.
1 man carting to pit and spreading.
Rolling done before and after cutting.
(2 men, 2 tractors, 2 trailers, 1 harvester with 3′ 4″ cut).

The second man is the lead operator:—

1st MAN	MINUTES
Cutting and loading 25 cwts.	9.50
Unhitching full trailer	0.97
Disconnecting and unhitching empty trailer	0.92
Hitching and connecting full trailer	1.28
Hitching empty trailer	1.00
Work cycle (Minutes)	13.67

2nd MAN

Transport distance (yards)	100	200	400	600	800
Waiting for 1 to unhitch	0.92	0.92	0.92	0.92	0.92
Backing and waiting for 1 to hitch	1.28	1.28	1.28	1.28	1.28
To silo	0.89	1.78	3.56	5.34	7.12
Onto clamp, tip load and off clamp ...	1.53	1.53	1.53	1.53	1.53
Spreading	10.20	10.20	10.20	10.20	10.20
To field	0.62	1.24	2.48	3.72	4.96
Work cycle (Minutes)	15.44	16.95	19.97	22.99	26.01
Man Minutes per Load	30.88	33.90	39.94	44.98	52.02
Rolling per Load	1.33	1.33	1.33	1.33	1.33
Contingencies and Relaxation Allowance	3.58	3.91	4.59	5.15	5.93
Total per Load	35.79	39.14	45.86	51.46	59.28
Tons per Man Hour	2.1	1.9	1.6	1.5	1.3

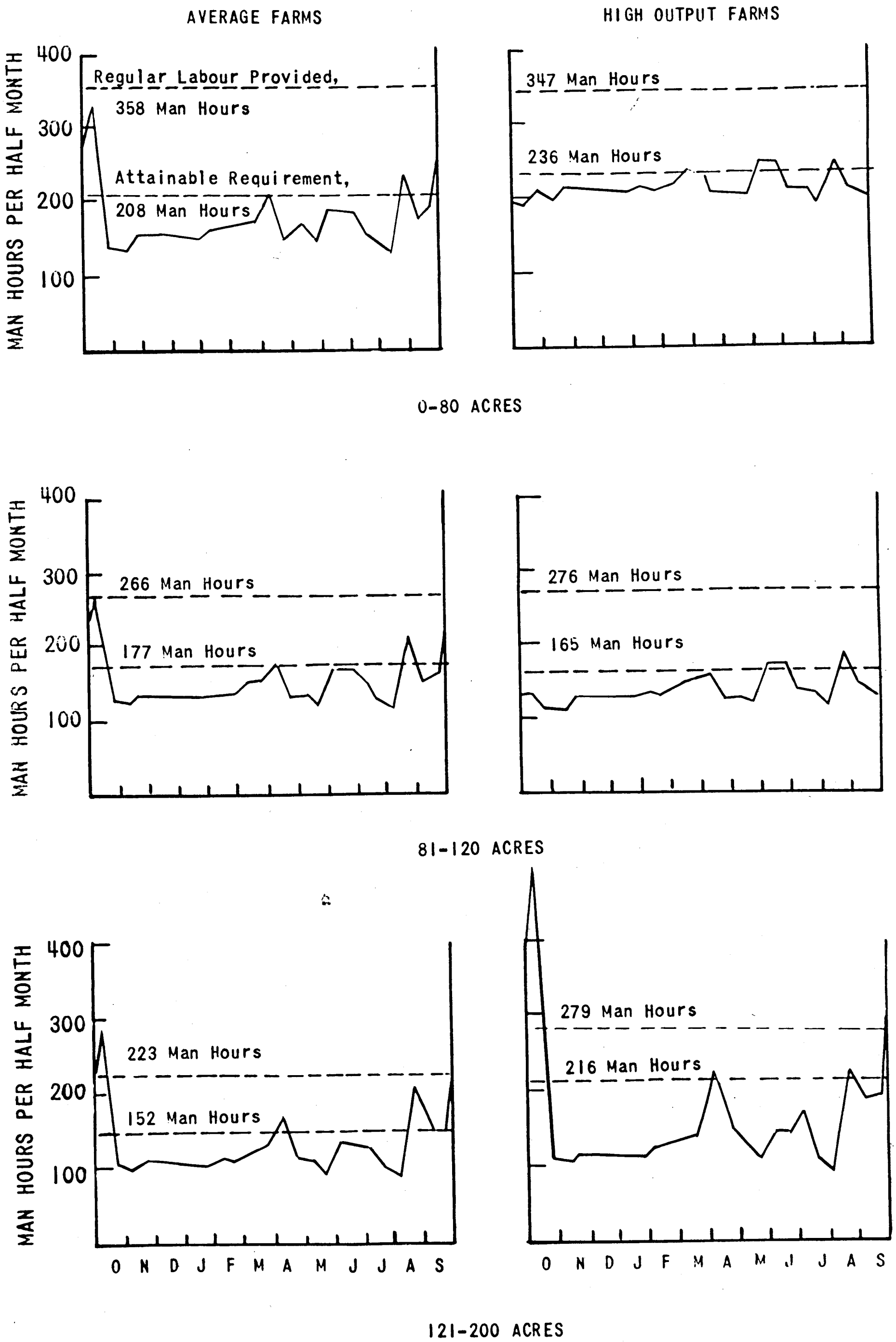
Method 4. 1 man with a small forage harvester cutting, loading, carting and spreading.
Rolling done before and after cutting.
(1 man, 1 tractor, 1 trailer, 1 harvester with 3′ 4″ cut).

Transport distance (Yards)	100	200	400	600	800
Cutting and loading 25 cwts.	9.50	9.50	9.50	9.50	9.50
Unhitching and hitching	3.12	3.12	3.12	3.12	3.12
To silo	0.89	1.78	3.56	5.34	7.12
Onto clamp, tip load and off clamp ...	1.53	1.53	1.53	1.53	1.53
Spreading	10.20	10.20	10.20	10.20	10.20
To field	0.62	1.24	2.48	3.72	4.96
Unhitching and hitching	3.33	3.33	3.33	3.33	3.33
Work cycle (Minutes)	29.19	30.70	33.72	36.74	39.76
Rolling per Load	1.33	1.33	1.33	1.33	1.33
Contingencies and Relaxation Allowance ...	3.39	3.56	3.89	4.23	4.57
Total per Load	33.91	35.59	38.94	42.30	45.66
Tons per Man Hour	2.2	2.1	1.9	1.8	1.6

Method 7. 1 man equipped with a tractor and rear-mounted buckrake.

Transport distance (Yards)	100	200	400	600	800
To field	0.52	1.05	2.10	3.15	4.20
Turning, backing to swathes and lowering rake	0.23	0.23	0.23	0.23	0.23
Picking up 6/7 cwts. grass	1.25	1.25	1.25	1.25	1.25
To silo	0.84	1.68	3.36	5.04	6.74
Onto clamp, drop load and off clamp ...	0.41	0.41	0.41	0.41	0.41
Spreading	1.06	1.06	1.06	1.06	1.06
Work cycle (Minutes)	4.31	5.68	8.41	11.14	13.89
Mowing per Load	1.78	1.78	1.78	1.78	1.78
Rolling per Load	0.44	0.44	0.44	0.44	0.44
Contingencies and Relaxation Allowance ...	0.73	0.88	1.18	1.48	1.79
Total (6.7 cwts.)	7.26	8.78	11.81	14.84	17.90
Tons per Man Hour	2.8	2.3	1.7	1.4	1.1

APPENDIX 9



APPENDIX 9. Attainable Stock, Crop and Regular Labour Requirements per 100 acres.

Some Recent Reports Published by The Department of Agricultural Economics.

Report	M.39	Economics of Milk Production 1956-57. An analysis of results from 32 farms in the Northern Counties.	Price 5/-
„	M.40	Milk Production from Grazing.	Price 3/-
„	FMS.42	Hill Sheep Farming in The Northern Counties An economic survey of selected farms.	Price 5/-
„	FMS.43	Profitability of Farming in The Northern Counties of England 1957-58 with a note on the small farmers' scheme.	Price 5/-
„	G.55	Poultry Management Survey. Summary of results from some commercial egg flocks in the Northern Counties 1955-56.	Price 2/-
„	139.M	Herd Maintenance on North of England Small Dairy Farms. A study of practices and farmer's opinions.	Price 2/6
„	140.M	Productivity and Efficiency of Labour Use on Small North of England Dairy Farms.	Price 5/-

The above are obtainable from The Department of Agricultural Economics,
University of Durham,
King's College,
8, Kensington Terrace,
Newcastle upon Tyne, 2.

KCPS1131.400.4.60