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Electricity and the Farm Business

A Study of Four Cases

by

V. BAKER, B.Sc. (Econ.)

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SECTION 1

INTRODUCTION

Pilot Farm Scheme

The scheme was devised by the South Western Electricity Board with the object of assessing the effect upon the farm economy of provision of mains electricity, where it is used to the full extent that the Board would expect to be economic. This main object arises from the relatively slight use made of electricity by so many farms that are connected, more especially in view of the high cost of rural electrification. A second object is also fulfilled by the scheme, namely, some enlargement of available data on operation of the various items of equipment in ordinary farm conditions.

The first step was to select farms which offered a prospect of several applications of electricity, and where the farmers were willing, on extended terms for capital expenditure, to install and use equipment as advised by the Board and to keep records of its use. They also provided information and facilities for study of certain aspects of their farming prior to electrification. Thus they do not pretend to be a representative sample of any particular group of farms, certainly not of all farms in the Board's Area: and the results are not suitable for multiplying-up to obtain an estimate of total effect. They are simply an an account of what was done in four cases where conditions were suitable and observation was possible.

It should perhaps be added that they were not handpicked to show cheap electrical and dear pre-electrical conditions. There is no reason to suppose that either set of circumstances is anything out of the ordinary.

The author, representing the University Agricultural Economics Department, has had the opportunity of watching the progress of the scheme from the start, in order that it might be possible to produce at the end an unbiased account of what has happened and what it means.

The Farms and the Farmers

A. Charmeydown Farm, near Bath: Mr. Jack Gay. Farm of 300 acres adjusted to 260*, with 80 acres cereals (one-quarter sold, three-quarters fed), 70 acres leys (20 each year for herbage seed), 110 of steep or rough Cotswold grazings: situated on

*Unless otherwise stated "adjusted acres" will be quoted rather than actual acres. The term means equivalent acres of average farmland, adjustment being made in the case of rough pasture or grazings taken for part of year.

the upper slopes close to Bath. Dairy herd of 55 mainly Ayrshire cows, increased from 45, aiming at 60, wintered in semi-covered yard and milked in 8 stall 4-unit parlour by one man. Other cattle about the same number, including beef crosses: 50 ewes: 8 breeding sows, also with numbers increasing. Regular staff has generally been four, aiming to do with three.

B. Higher Monkton Farm, Stogursey: Mr. L. E. Miller. Farm of 160 acres including some marsh grazing with 35 acres cereals (one-third sold), 10 acres roots and fodders, 45 acres leys and 70 of permanent grass: situated in rolling country north of Bridgwater, in the corner between the Quantocks and the sea. Dairy herd of 28 Shorthorns and Friesians and 5 cows for rearing; mainly put to Devon bull: all calves reared for sale fat or for herd replacement. Other cattle therefore about 70: about 100 sheep bought for fattening: 35 Wessex sows, the progeny (crossed L.W.) mainly sold fat, but an appreciable number of crossed sows and gilts either with litters or in pig are sold: about 30 of each last year. Mr. Miller and his wife are assisted by two full-time men; some summer casual help.

C. Crablake Farm, Exminster: Mr. A. Gibbs. Farm of 250 acres with 85 acres barley (three-quarters sold), 20 acres potatoes, 35 of forage crops, 60 of leys and 50 permanent grazing. Dairy herd of 35 mainly Friesian cows, wintered in covered yard and shift milked in byre: all progeny reared for replacement or sale as stores: 70 other cattle. 60 ewes folded: a few poultry. The farm estends up the hill from the marsh grazing bordering the Exe estuary: Mr. Gibbs took it over ten years ago in very poor condition and considers fertility still not as it should be. He is the only one of the four who has not farmed all his life. He has a man and boy in the dairy, a part-time worker, and three regular outside staff now to be reduced, it is hoped, to two.

D. Great Hewas Farm, Truro: Mr. F. Dymond. Farm of 140 acres, 30 in feed cereals (planned to decrease), 5 acres fodders and the rest grass all reseeded. Beef herd of 80 head, mainly fattening from purchase as calves; 120 breeding ewes; 20 sows, with progeny sold fat as far as space permits; 1,200 hens on deep litter. The aim is to extend the cattle fattening side for which the farm is well suited, and expand the pigs. Mr. Dymond is assisted by one man, his son and another regular young worker, with some part-time help.

The range of type of farm is thus fairly widely representative of types of farm in the Board's Area, with the emphasis, as it should be, on milk, but including varied cropping, stock raising, and some substantial pig and poultry units. The sizes also may be described as typical—that is to say, in the range of farm-size which includes a great part of the farmland of these counties.

A word may perhaps be said of the type of farmer. In this respect also, while showing a proper variety, the sample is well in the middle range, including no hobby or spare-time farmer, but serious commercial people intent on making a living for themselves and their families and on doing well by their land.

Electricity Consumption and Cost

Farm A was connected in September, 1958, B in October, 1959, C in August, 1959, and D in July, 1959. Their total consumption for farm use in the last available four quarters, and the charges made, are given in Table 1. The fixed charge is the method adopted by the Board of covering certain overheads however few units are consumed. All energy is charged at 1.125d. per unit. The Rural Development Contribution is based on farm acreage, and subject to rebate based on level of consumption. The R.D.C. is a payment towards the cost of the fixed mains and distribution equipment which the Board has to provide when electricity is newly connected to a farm. It is payable in the case of these farms only for the first seven years of connection, and is eligible for Farm Improvement Scheme grant which is deducted in these calculations. On Farm A the rebate earned was such that no R.D.C. was paid.

When the cost of various applications of electricity are being weighed up in this report, units consumed are charged at the average cost of all the farm (not domestic) units on the farm in question. It may be worth recalling, however, that the marginal (additional) cost of an extra unit is always 1.125d. In fact on farms where R.D.C. is being paid and where consumption exceeds a minimum level—which it is the case on Farms B, C and D—each unit earns rebate to the extent of one quarter of its cost, so that the marginal cost is only 0.844d.

The average costs of farm units are made up as follows:—

TABLE 1

Annual Cost of Farm Energy, 1960 (£)

	Units Consumed	Unit Charge	Fixed Charge	Assessed R.D.C.	R.D.C. paid	Total Cost
Farm A	30,102	141·1	17·3	23·3	—	158·4
(pence	per unit)	(1·125)	(0·14)			(1·26)
Farm B	7,872	36·9	13·0	19·2	14·7	64.6
(pence	per unit)	(1·125)	(0·40)		(0.45)	(1·97)
Farm C	14,520	68·1	13·0	23·3	9·8	(90·9)
(pence	per unit)	(1·125)	(0·22)		(0·16)	(1·50)
Farm D	15,350	72·0	17·3	22·3	9·6	98·3
(pence	per unit)	(1·125)	(0·27)		(0·15)	(1·54)

Calculations in this report are based on average practice on these farms since electricity was put in. But Table 1, and the energy cost which is used in the calculations, relates to 1960. This is the reason for the discrepancy between the total energy charges given in Table 2, and those given in Tables 14, 16, 18, and 20. The differences are small, except in the case of Farm A where the wet season in 1960 led to high energy consumption for grain drying. This leads in turn to a slightly lower per unit charge (that for 1960) being used than is strictly appropriate to the " normal " consumption level. The error is so slight as to be thought not worth correcting.

Equipment Cost

Except in special cases where different rates were suspected or known to be more appropriate, one-fifteenth of the initial cost of equipment is charged as annual depreciation, and the annual cost of maintenance and repair over the equipment's life is estimated at one-twentieth of its original price. The same rates are used for electrical and pre-electrical equipment. Some of the principles underlying the depreciation estimation are discussed on page 12.

To calculate or allow for the annual cost of wiring, switch-gear, etc., a lower rate of depreciation has been used on account of its longer physical life than most equipment items, and of the possibility that it might equally serve different equipment, obsolescence thus being less.

SECTION 2

ELECTRICAL APPLICATIONS

The aim here is to review in turn each of the farm operations which have been affected by the coming of the Board's electricity on the four farms, and where appropriate to compare what happens now (E) with what happened when there was no public electricity (N.E.).

Electrical Generation

This is not strictly a farm operation; but two of the farms had generating plants for lighting, and in one case (A) for other domestic equipment, water pumping and machine milking. Records were kept of the operation of these plants, and are summarised in Table 2.

TABLE 2

Cost of Privately Generated Electricity

	Plant		Maintenance	Annual Units	Fuel and Oil			Total Cost	
	Initial £	Annual £	£		gals. f/o	cost £	pence p.u.	Annual £	pence p.u.
A	405	41·0	12·7	3,890	626/12	49·8	3·1	103·5	6·5
C	165	16·5	4·0*	1,200	234/10	29·0	5·8	49·5	9·9

*Estimated

The equipment at A was a 230v. 3kVA Diesel Alternator, and at C a 50v. 2kW generator with engine, also running on gas oil, and batteries. The figures are based on records kept over a period in each case, except that for maintenance at C which is an estimate inserted to complete the comparison.

The electrical units provided in this way were far more expensive per unit than those consumed later under supply from the Board. Farm A later took 37,000 units per annum for £207, which is 1.3d. each, and Farm C, 24,000 units for £151, which is 1.5d. per unit. If they had consumed the former small amounts at the Board's charges, the cost per unit would have been higher; in fact at C it would apparently have closely approached the N.E. cost. But such calculations have little relevance since the point of being connected to Board's system is that ample supplies are available at a very low marginal or additional cost for each unit. As in so many instances, electricity does not mean doing the same things in a different way, either cheaper or dearer. To a greater or lesser extent it alters the conditions of life and of production: different things are done.

The disadvantage of the private supply, even in the case of A, with an efficient generating system of reasonable capacity, lay in the limited load that was available, on pain of automatic cut-out, awkward when milking; and the relatively high marginal costs of 3.1d. (A) and 5.8d. (C), as against 1.125d. from the Board. A higher peak could have been managed with larger plants, but clearly this could have involved considerable investment.

Machine Milking

The cost of electrical equipment to power the vacuum pump on the three dairy farms, and the annual cost of running it, are as follows:—

TABLE 3

Cost (£) of Power for Milking (Electrical)

	Equipment	Cost		Main-tenance	Energy		Total Cost	Cows	Cost per Cow
		Initial	Annual		Units	Costs			
A	(No change) .	25·0*	1·7*	1·2*	1500	7·9	10·8	55	0·20
B	2 motors Wiring . .	40·0 16·5	3·5	2·0	830	6·8	12·3	28	0·44
C	Motor . . Wiring . .	22·2 5·0	1·7	1·1	1170	7·3	10·1	35	0·29

*Estimated.

Units consumed are roughly proportional to cows, at 27, 30 and 33 per cow respectively. Total cost per cow at B is influenced by the higher cost per unit and the rather complicated milking arrangement in sheds by one portable and one stationery plant, replacing two portable petrol-driven milkers. At A, the motor formerly driven by the private generating plant remained unchanged: comparable equipment cost is inserted.

The previous cost is shown in the next Table.

TABLE 4

Cost (£) of Power for Milking ("Non-Electrical")

	Equipment	Cost		Main-tenance	Petrol/Oil		Total Cost	Cows	Cost per Cow
		Initial	Annual		gals.	Cost			
A	Motor as now	25·0*	1·7*	1·2*	1500 units	39·8	42·7	55	0·78
B	2 portable engines .	40·0	5·0	8·0	82*	34·2	47·2	28	1·69
C	Engine . .	25·0*	3·0*	5·0*	242/12	54·0	62·0	35	1·77

*Estimated

The total cost for the whole herd on the three farms has come down by figures ranging from about £30 to about £50 per year, and the cost per cow is reduced to a quarter or less of the previous cost, whether it was previously done by petrol engine or by way of home-generated electricity. The relatively high cost of maintenance at farm B will be noted: this is based on actual records of expenditure.

As regards effectiveness with which the job is done, no difference is reported. As to reliability, electricity can fail but a standby is really needed in any case. There will be a very small saving of labour spent on servicing the petrol engine, and on the odd occasions when it is difficult to start. The comparison between the two methods is almost entirely one of cost.

Water Heating and Steam Raising

This is another widespread application for electricity on dairy farms, the predominant type of farm in the Board's area. On Farm A, steam sterilising is favoured, and a combined water heater and steam raiser was installed; the others had water heaters only.

TABLE 5

Cost (£) of Hot Water and Steam (£) (Electrical)

	Equipment	Cost		Maintenance	Energy		Total Cost	Gall. Water	Pence per Gall.
		Initial	Annual		Units	Cost			
A	Heater/Steam Raiser . . Wiring . .	178·0 28·6	11·9 1·4	8·9	4350/ 2980	38·3	60·5	8400	1·7
B	Heater . . Wiring . .	20·0 9·9	1·3	1·2	1660	13·6	16·1	5100	0·76
C	Heater . . Time Switch . Wiring . .	23·4 5·2 2·6	1·9	1·5	3500	21·9	25·3	8800	0·69

In the case of the combined equipment at A, the units used by the steam raiser and water heater were metered separately; but the other measurements cannot be separated since the equipment is a single unit, and the steam raiser used water heated by the heater. The cost of 1.7 pence per gallon is therefore for heating the measured quantity of water and also producing the steam required for sterilising.

Comparable figures for hot water and steam before the farms were connected are given in Table 6.

TABLE 6

Cost (£) of Hot Water and Steam (Non-Electrical)

	Equipment	Cost		Maint-tenance	Fuel	Cost	Total Cost	Gall. Water	Pence per Gall.
		Initial	Annual						
A	Boiler . .	40*	2·7*	2·0*	Coal TVO	65·7 2·0	72·4	3800	4·6*
B	Old Copper .	—	—	—	Coal/ Coke	13·5	15·1	3600	1·01
					TVO	1·6			
C	Gas Boiler .	8	0·5	0·4	Calor Gas	25·7	26·6	6600	0·95

*Estimated

The high figure of 4.6 pence per gallon at A is not exactly comparable with the 1.7 pence with electricity, since in each case the sterilising steam is produced in addition to the measured water by which the cost is divided. The less water is heated the higher its cost will appear, since it bears the cost of the (unmeasured) steam. The real comparison can be expressed by saying that £13 or 18 per cent of the former cost was saved, and more than twice as much hot water made available.

The other two comparisons, with two entirely different types of non-electrical equipment, show electrical costs per gallon of hot water alone which are lower by 25 per cent and 27 per cent respectively. In both cases more water was used, so that the cost per herd was little different from before.

From the investment-and-returns angle, it can be said broadly that on a sheer cash-cost saving basis the higher level of investment in the electrical equipment is worth while. For this purpose it is fair to estimate what the cost would have been if the former equipment had produced the same hot water, and compare the cost saving with say half of the difference in initial cost of equipment and wiring. The results of such admittedly imprecise figuring might reasonably show savings of £30, £5 and £10 on the respective farms in return for increased investment levels of £170, £15 and £7.

Direct cash effects however are by no means the whole story. On Farm C where the previous service given was the most comparable and little more labour was required for the non-electric system, the return on investment is the best. Actual cost for the herd (with the increased water) is barely reduced: but the value of ample hot water immediately on tap first thing in the morning (this is the purpose of the time switch) as compared with dishing it out of a wash boiler of limited capacity can hardly be questioned.

At B, the former equipment was primitive and dirty to operate: the fire had to be lit, and needed a second stoking to get the water warm enough. Time studies were made here, and labour is estimated to have been seventy hours per annum. The advantages of eliminating this regular chore is to be added to an improvement in effectiveness similar to that at C.

Raising steam in the old boiler at farm A took even longer in manhours (150 per annum). No hot water was available for the start of the morning milking under this delayed system of water heating and since the fire was out in the afternoon there was none for the afternoon milking: it was carried from the house. This is a notable disadvantage, especially for a herd of this size.

The increased quantity of water used in every case is a reflection of the ease of obtaining it. This is another example of the impossibility of making a direct economic comparison in cash terms, since the conditions of work and of production were altered by the new facilities. Where the effect of this might appear on the profit and loss account is hard to say—whether under labour, due perhaps to this saving tipping the balance in favour of disposing with casual or regular labour, or under milk sales due to better cleanliness or to attraction of good cowmen. All that can be said about effects of these kinds is that their occurrence at some time or other is probable, but that they can very rarely be exactly calculated.

Water Pumping

This is a function performed very cheaply and conveniently by electrical power. On Farm A, where farm and domestic water is taken from public supply, electricity has still found a use in powering a pressure pump for washing down the milking parlour by forced water jet. The effectiveness of this has greatly impressed the farmer and cowman: as compared with dipping a bucket in a tank, tipping on floor and hand brushing (it does a better job, especially on walls) it uses less water and greatly reduces labour hours (which can be measured), and effort (which can not). The last point is of particular relevance on this farm where the herd is already a large one-man unit and is being expanded.

Table 7 summarises the effect of this installation, and of the pumps for domestic and farm supply installed at Farm C, and for domestic supply at Farm D. On Farm B it is intended to extend the water supply to fields with the help of electricity, but neither performance data nor non-electrical comparison are yet available for that project.

The cost comparison of pressure pump with hand brushing on Farm A shows that the saving in water, at the actual cost of water at the farm, roughly pays for the equipment, and over an hour a day of labour is saved in addition.

TABLE 7

Cost (£) of Electrical and Non-Electrical Water Pumping

	Equipment	Cost		Main-ten-ance	Variable Costs	Total Cost	Pence per 1000 gall. (1000 gall.)	La-bour hours
		Initial	Annual					
A	(E) Pump Wiring	54·5 5·0	3·9	2·7	0·5 (100 units) 5·0 (36000 gal)	12·1		150
	(NE) Bucket & brush				10·0 (72000 „)	10·0		600
C	(E) Pump . Wiring	44·3 14·2	3·7	2·2	6·2 (1000 units)	12·1	6·6 (390)	—
	(NE) Pump .	35	3·3	2·4	Petrol/Oil 230/12 gall. 52·6	58·3	35·9 (390)	—
D	(E) Pump . Wiring	12·0 4·6	1·0	0·6	0·1 (18 units)	1·7	8·7 (44)	—
	(NE) Hand . pumping							150

The electrical pumps at Farms C and D are of very different capacities: at C, all house and farmstead water is pumped, and at D only domestic washing water. The electrical cost per thousand gallons is fairly similar in the two cases, although one is composed of 53 per cent energy costs and the other 94 per cent equipment costs. In the one case the former petrol driven pumping had cost five times as much, 90 per cent of the cost being for fuel. In the other, 150 hours of farm labour per year (25 minutes a day) had formerly been needed for this purpose and was released for other work at a cost of 34/–.

Milling and Mixing

New electrically driven equipment for these purposes was installed at all four farms. Costs are summarised in Table 8.

Total cost per ton mixed, varying proportions of the tonnage having been milled or crushed as well, varies between 9/– and 27/–. The differences derive mainly from the tonnage put through, since the bulk of the cost consists of overheads.

This is a point where these estimates of annual equipment cost are important. Where the sums concerned are small, the method of calculation need not be so closely examined. Does it look reasonable in this case?

The length of time over which a piece of equipment should be expected to repay its cost is an important ingredient in the decision whether to have it: but it is a far from straightforward figure to calculate. Physically, it might be said that equipment such as this, properly maintained, would last very much longer than the fifteen years here taken as standard. But it is not simply, or perhaps mainly, a matter of estimating physical endurance, but rather of making a considered judgment on the certainty or uncertainty of the farmer or the farm requiring the machinery for this period. The main risks are of the nature of (a) obsolescence, that is supersession of this equipment by other ways of feed processing, (b) change in the relative competitive advantage of home and merchant's processing, either generally or for this farm in particular, (c) change in the amount of feed required due to change in farming system or production methods. When the pace of current technical and economic change is borne in mind, fifteen years of steady use may well seem rather a long than a short "mean expectation of life".

TABLE 8

Cost (£) of milling and mixing (E)

	Equipment	Cost		Main-ten-ance	Energy		Total Cost	Tons	C.p.t. Mixed	La-bour hours
		Initial	Annual		Units	Cost				
A	Mill/ Crusher Mixer Wiring .	473 (16)	32·3	23·6	2070 270	12·3	68·2	80 157	0·44	92
B	Mill . Mixer . Wiring .	366 11·3	25·0	18·3	1370 170	11·8	55·1	37 82	0·67	74
C	Mill/ Crusher Mixer . Wiring .	465 (24)	32·2	23·2	1040	6·5	61·9	31 45	1·37	(50)
D	Mill . Mixer . Wiring .	414 12·2	28·2	20·7	806	5·2	54·1	45 56	0·97	16

The estimation of annual maintenance costs at 5 per cent of initial price is thought to be probably high for the electrical components of plant such as this, but not for the mechanical parts, which are subject to considerable wear and risk of damage. There is however a case for regarding the greater part of the maintenance cost as variable with output. This would "iron out" about half of the variation between farms in respect of calculated cost per ton. But if 5 per cent is regarded as a suitable estimate for the average throughput on these farms, it would leave the average cost per ton about the same, at 17/– or so.

The energy cost by itself is very low, being of the order of 2/––3/– per ton processed. Figures for the plants where energy for the different processes could be recorded separately show mixing to take about 2 units per ton (3d.), grinding about 35 units (4/–) and crushing probably about 20 units (2/6d.).

These are all modern well-designed plants, with horizontal-type mixers which have been found entirely effective, and labour-saving layout for putting in and bagging off material. At C and D the milling and mixing are integrated: hence the impossibility of measuring energy used for parts of the process separately. In three cases, A, B and D, time studies were carried out on the labour required per batch put through; the annual estimates in the Table are based on those studies. The figure at C is based on an estimation by the farmer. The measured figures vary from 17 to 54 minutes per ton.

All farms have recorded pre-electrical experience of either milling and mixing on the farm or of sending away home grown grain for this purpose. This is tabulated below.

TABLE 9

Cost (£) of Milling and Mixing (N.E.)

	Equipment	Cost		Main-tenance	Running		Total Cost	Tons	C.p.t. Mixed	La-bour hours
		Initial	Annual			Cost				
A	Crusher .	50*	3·3*	2·5*	175 Tractor hours	35	40·8	50	0·41	660
	Mixing by hand .							100		
B	Mill/Crusher	140*	9·3*	7·0*	131 Tractor hours	26	42·3	37	0·52	130
	Mixing by Hand .							82		80
C	Feed sent away for preparation .				Ground	78	115	26	2·55	50*
					Crushed	18		6		
					Mixed	19		45		
D	Sent away, ground and crushed . .					112	112	45	2·00	16*
	Mixing by Hand					—		56		93

*Estimate

At Farms A and B there were milling or crushing machines driven by tractor, involving tractor running costs which are charged at the rate of 4/– per hour. This is not fairly comparable with the electrical energy cost, since it includes a depreciation and maintenance element as well as fuel. The total cost per ton ground or crushed comes to 16/– and 23/– respectively, the tractor portion 14/– in each case, and the fuel element in the tractor cost about 3/6d. This fuel figure is similar to the electrical energy cost for the same operation. It is not possible to compare the total cost for the grinding alone, since the "electrical" equipment figures are not split, but clearly there will not be much difference. The best comparison on these two farms is made by noting that the total costs per ton prepared are similar in each case, but that additional labour was used to the extent of $3\frac{1}{2}$ and $1\frac{3}{4}$ hours per ton respectively, and almost certainly a much better mixing job was done. Also farm A now has the advantage of grinding as well as crushing equipment, needed for the developing pig enterprise. What has happened is that some efficient and convenient machinery has been introduced on these farms, cheaply and conveniently powered by electricity.

The comparison at Farms C and D is with feed preparation on contract. These are the farms with smaller throughput and higher "electrical" costs. This is no coincidence: the smaller the tonnage the more competitive the contractor's flat rate becomes. Still, the charges, even at these tonnages, are about double the "electrical" estimated costs: and in one case there was still 1.7 hours per ton to be spent on hand mixing.

The investment involved is of course quite substantial. In the latter two cases, the average money which may be considered to be laid out on this equipment would be about £300, and the cash saving at this level of throughput about £50, which at 17% makes this a quite sound competitor for a farmer's capital. In the first two cases the additional investment is rather less, but the clear return is less—it comes in the form of spare tractor and man time for other operations, and better-mixed feed.

It should be added that this investment has provided plenty of spare capacity. If throughput were increased, as it could well be on three of the farms, the cost per ton could clearly fall considerably.

Crop Drying

In the case of the two applications which remain to be considered, electricity enters even more intimately into the production process, altering its nature. As compared with an application which simply for example replaces one kind of motor with another kind of motor, these latter types of change associated with the introduction of electricity have effects which may be very far-reaching, but which are very difficult to assess.

The old grain dryer on Farm A was inexpensive in respect of equipment and running cost, and it was originally intended, as far as the pilot farm scheme was concerned, to continue to bear its serious shortcomings. A handy dryer was in fact installed: but as it was not in the scheme, the usual before-and-after records were not kept. To give a general picture of the change however, it may be estimated that £750 of equipment and £130 expenditure on wiring (depreciation and maintenance

£94) enable the farmer to dry 70 tons for £50 worth of units, while previously with very cheap home-made equipment requiring the constant presence of a man and tractor (to put through 2 tons per day) some 30 tons were dried by a ton of coke costing about £9. Thus to double the amount dried, direct equipment and running costs of say £15 plus £20 for the tractor have risen to about £144. To conclude however as the Board and the farmer did (beforehand) that this would not be an economically justifiable use of electricity is to take too narrow a view. The value of Farm A's grain, apart from acreage payments, is some £2,200, and corn harvest is a time of high labour and tractor requirement. The effect cannot be calculated, but it is clearly probable that the practical ability to dry a larger part of the crop, the elimination of the risk of overheating during drying, and the release of man and tractor power at this time of the year will amply repay the extra annual £110 expended. The old dryer was of a fixed tray type on to which bags were emptied, the new a tilted batch dryer with intake pit, by means of which, with a tanker combine, the farmer can now carry on harvesting with a boy's help.

The other two plants are designed for sacks or bales, and have been used for both grain and hay. In both cases grain was previously sent away for drying.

TABLE 10

Cost (£) of Crop Drying (E) and Grain Drying (N.E.)

	Equipment	Cost		Maintenance	Crop (Tons)	Energy		Total Cost	Cost Per Ton
		Initial	Annual			Units	Cost		
	ELECTRICAL								
C	Dryer .	360	25·5	18·0	Hay (11·5)	3270	20·4	42·8	3·73
	Wiring .	30*			Grain (44)	3071	19·2	40·3	0·92
D	Dryer .	317	21·6	15·8	Hay (12)	3600	23·1	38·4	3·20
	Wiring .	10			Grain (40)	5200	33·4	55·5	1·39
	NON-ELECTRICAL								
C	Grain sent away for drying . .				(25)			60·5	2·42
D	Grain sent away for drying . .				(40)			100·0	2·50

*Estimate

Equipment costs in the Table have been allocated to hay and grain dried in proportion to the number of units consumed by those crops. On this rating the cost for drying hay was well over £3 per ton dried, of which nearly £2 was energy cost. Any method of splitting the equipment cost between the crops is very largely artificial. Other methods which might be thought attractive are proportionaly to tonnage, or to value of product, or allocation of all to grain drying on the ground that hay drying is a "by-product", leaving the hay with the energy cost only.

The barn-dried hay on both farms was decidedly better than any hay which had previously been made. It was not analysed, however, and if it were, it would still not be possible to put a certain figure on the extra value of it in terms of livestock output net of concentrates. The figure would depend on the economy with which it was fed, the type of livestock to which it was fed and in some cases the market for that livestock. Some estimate can be made below, when the effect on the economy of the whole farms is being considered.

As regards grain, the cash comparison with the previous practice shows both farms to be better off, even without any allowance for the higher tonnage now dried on Farm C. As in other instances, the direct comparison per ton does not quite reflect the effect of the change—it exaggerates it—nor does the comparison of total costs, which understates it. More drying is done because it has become cheaper and easier. The soundest way to describe the change is to say that total cost has been reduced, and facilities provided which should, in various ways, lead to increased output.

The labour effect of the crop-drying installations on these two farms is probably slight. The sending away of grain and the handling of naturally-cured hay in the field both require labour. The operation of the drying plants, which replaced these tasks, in all probability requires a little more labour; but the farmers did not think the difference important.

It will be noted that these drying applications of electricity use a substantial amount of energy: its annual cost is greater than the calculated annual equipment cost. It is still true that the cost per unit of crop processed depends quite substantially on the number of units. These plants could handle more grain, but not very much more—they are quite appropriate to the recorded throughputs. Their capacity for grass very much depends on grass management. They handle about 5 tons of hay per week: therefore if grass at roughly normal hay stage is being dealt with and no special off peak cuts are provided, they will hardly handle more than 15 tons at the outside. On the other hand there is scope for feeding such dryers over a much longer period, if a farmer has a use for a larger tonnage of super-hay, and will put himself out to organise it. These are both first-season results, and both farmers intend to produce as much as possible in future. The cost of additional tons put through is of course the "marginal" one of about £2 per ton—or strictly, a good deal less than this if units are charged at their marginal cost (see above, p 5). The units consumed per ton can themselves be reduced by more successful wilting before the grass is baled. But the longer the season of drying, the more difficult this may be to achieve, due to unfavourable weather.

Infra-red Heating

On the three farms where pigs are kept, farrowing and rearing pens were fitted up with infra-red heating.. Annual costs were as follows.

TABLE 11

Cost (£) of Infra-Red Heating for Pigs

	Equipment	Initial Cost	Maintenance	Energy		Total Cost	No. of Sows	Cost per Sow
				Units	Cost			
A	Lamps	10	3·5	1,470	7·8	12·3	8	1·54
	Wiring	10	1·0					
B	Lamps	22	7·7	5,230	42·9	51·6	40	1·29
	Wiring	10	1·0					
D	Lamps	15	5·2	3,400	21·8	27·5	20	1·38
	Wiring	5	0·5					

Equipment maintenance rates have been adjusted in accordance with the type of equipment. In each of these cases half the lamps were of the glowing type, half of the dull emitter type which costs more but lasts longer. When total costs are related to the number of sows in the breeding herd, the annual expenditure is seen to be in the range 25/– to 30/– per sow.

At Farm B, one paraffin pressure lamp was in use before electricity arrived. To do the work later done by the electric lamps, i.e. 21,000 hours per year, at least three such lamps would have been needed, with initial and annual maintenance cost amounting to very much the same as the electrical equipment, and fuel cost in the region of £30. The electric lamps thus cost about £13 or more, or about 7/- more per sow. Tests shows this paraffin lamp to produce a little less heat than the (glowing) electric lamps, but the farmer considered the electric lamps more effective not so much for this reason but because of the amount of care and attention that needed to be devoted to the paraffin lamp to make it work steadily and reliably, and the fact that in spite of his best efforts it occasionally failed. It is estimated that at least one hour per day over the year will have been required to operate the three lamps. The labour actually spent on the one lamp would be about one third of this, namely 130 hours per year.

All these farmers were emphatic about the effect of infra-red heating on the number of weaners reared per litter. Some estimates will be made for the individual farms of what this might have amounted to in terms of production and income.

Deep-Litter Lighting

One other application where electricity replaced a comparable previous method occurred at Farm D. Here a unit of 1,200 laying birds on deep litter was provided with extended daylight lighting—electricity replaced bottled gas.

TABLE 12

Cost (£) of Electrical and Gas Poultry Lighting (D)

Equipment	Cost		Maintenance	Variable Costs	Total Cost
	Initial	Annual			
(E) Wiring . .	17·2	0·9	1·0*	880 units 5·6	7·5
(NE) Bottled Gas .	34·8	2·3	1·7	14·8	17·8

*Estimate

The lighting provided by fourteen 100-watt lamps is far greater and more evenly distributed than that of six bottled gas lamps supplemented by some paraffin lamps. The electric lighting is controlled by time switch, which ensures regularity and adequate dimming, whereas attention to the gas lamps, besides the considerable inconvenience of demanding someone's presence at a particular time of day, is estimated to have occupied 90 hours in a year. The greater effectiveness and regularity of the new lighting, together with the saving of trouble, are likely to be more important than the cost saving shown in Table 12.

Sundry Applications

In addition to the applications which have been analysed, electricity was used for a number of other farm purposes. The buildings were of course wired for lighting, and a number of socket outlets were provided which have been used for sheep shearing and a variety of power-tools.

SECTION 3

IMPACT ON THE FARM BUSINESS

For the purpose of weighing this up on each farm, and considering it in relation to the economy of the farm, the direct procedure would seem to be to analyse the actual farm accounts before and after introduction of the Board's electricity. In practice, however, such a procedure would be misleading and unsuitable. A farm financial result varies from year to year with changes in policy, rotation, and prices, to an extent that would smother the modest effects we are trying to assess. Furthermore, the registering of peculiarities of any kind in the circumstances or results on these farms would not assist, but rather detract from, the object in view, which is to use these examples to illustrate the economic effect of electrical supply on normal farms. Therefore, a standard financial result for each of these farms has been built up from the various livestock and crop enterprises which are carried on, assuming in every case fairly successful levels of output and cost.

Farm A

A standard economic summary of Farm A's system looks like this (Table 13).

TABLE 13

Input, Output and Investment (A)

Input	£	*Output*	£
Labour	2,300	Crops	3,100
Concentrates	3,300	Milk	6,200
Power	1,800	Cattle, Sheep	1,700
Other	2,800	Pigs	1,600
		Sundry	300
Total	10,200		
		Total	12,900
Profit	2,700		
		Tenant's Capital	10,400

The input side in the Table includes a value to represent, at equivalent cost price, manual family labour, also the value, at sale price, of home-grown grain feed. This last is also credited to crops as output. Livestock output is stated net of livestock purchases.

The more directly-traceable influences which electric supply and its associated changes would have upon these figures are summarised in Table 14.

TABLE 14

Direct Consequences, Farm A (£)

	Annual Equipment		Fuel or Energy		Average Investment		Labour (hours)	
	—	+	—	+	—	+	—	+
Generator . .	29		27		109			
Milker . . .				8				
Water Heater .	5	22	68	38	20	103	150	
Water Pump . .		6	10*	6*		30	600	150
Mill Mixer . .	6	56	35	12	25	245	660	90
Dryer . . .	6	94	29	50	20	440	120	
Infra-Red . .		4		8		10		
Power Tools . .		14		1		60		
Buildings, Wiring and Lighting .		3		1		15		
Total . . .	46	199	169	124	174	903	1530	240

*Including the alteration in the cost of water.

This shows that annual costs of providing and maintaining equipment are likely to be up by about £150, and cost of running it down by £40, leaving total power costs, estimated in Table 13, at £1,800, up by some £110, or about 6 per cent. The average investment by the farmer is estimated to be raised by £740, which is 7 per cent of tenants capital. Average additional investment is reckoned at half of initial investment. This is done for the purpose of relating it to the previous level of investment, which includes equipment at written-down values. From the point of view of impact, that is money to be found at the start, the money to buy the electrically-powered equipment is twice this sum, namely 14 per cent of the money already in the business. Nearly half of the £1,800 investment was for the new grain drying equipment which did not form part of the original scheme. The table also shows that when the effect on hours of farm work is added up, in the applications where this effect has been estimated, about 1,300 hours or half a man's time are reckoned to be saved. This saving cannot be translated into a direct financial consequence, although it is so large that there is clearly a possibliity of its affecting the regular labour requirement of the farm: or if it does not do this, of its enabling something else to be done or something to be better done, some overtime to be reduced or leisure to accrue at some point.

Indirect Consequences, Farm A

As compared with the measurable effects, these may be relatively large, but they are relatively uncertain. Their degree of uncertainty varies, starting with the highly probable and tailing off into idle speculation. The following estimated values of indirect consequences are the best basis the writer can offer for judging the probable total influence of the electricity-using equipment.

Tacking the dairy equipment first, the milking-machine motor is the same as was previously driven by the farm generator, so that there is no effect here on the productive process. On many farms, it would be expected that sterilising would be more regular and effective where it can be done more easily. But farmer A was very thorough in his use of the old equipment, even though it took a lot of time and trouble. This illustrates the fact that many tasks and operations can be performed perfectly satisfactorily with inexpensive old-fashioned equipment. In this case, it was expensive to run, though not to provide.

The pressure pump for washing down, judging from measurements and reports of its advantages, seems to be decidedly more effective in cleaning the parlour. This is obviously an improvement, but the financial advantage of it is unlikely to be appreciable. The operator's preference for it is so decided, however, that it is hardly possible to do other than attach a labour amenity value to it, based on the idea of the additional pay that an otherwise identical post without it would have to carry to be equally attractive: say £10 per year, as a minimum perceptible wage difference.

The tractor requirement of the former grain crusher, of nearly 2 hours weekly, is rather unlikely to have had an effect worth mentioning on the farm's tractor needs or the timely performance of other tasks. The precise point of time when this job is done can be chosen within fairly wide limits.

The advantage of being able to grind and efficiently mix concentrate is most realistically assessed on this farm by regarding it as contributing to the expansion and profitability of the pig enterprise. It is partly into this development that the labour and "management", saved by electrical simplification, has been diverted. And there is a probability of noticeable improvement in technical efficiency in this enterprise consequent on the availability of infra-red heating.

Taking the last first, it can be calculated that the sows in 1960 are likely to have consumed about £240 worth of feed, and cost £30 in depreciation. Supposing that with infra-red heating each sow produces 10 per cent more piglets per annum, we may say that the same amount of fattening can be done for 10 per cent less sow cost, or £27 saving. We may go further and say that more fattening is likely to be possible, in the accommodation vacated by the sow. The profit on this might raise the estimated advantage derived from infra-red from £27 to £40.

When we come to estimate the profit due to expansion of the pig enterprise—which is still continuing—allowing for the other investment involved and for the fact that it is hardly fair to credit all to electrical supply, we are on more uncertain ground. We should rightly hesitate to tread it at all were it not that as a matter of practical historical cause and effect this development on the farm has been closely associated with this new equipment and facilities. Being very conservative, then, and basing the calculation on development to the 1960 stage, from gross output £400 to £1,600, and supposing a profit after paying off pig equipment, but not for labour (which was "provided" by electricity) of 10 per cent of the output increase, we have an estimated gain of £120 per annum on this score.

The advantage of the new grain dryer replacing a home-made coke-fired tray dryer on this farm has been discussed in Section 2. It is most fairly regarded as contributing to the material easing of the labour position on the farm which has been felt since these changes were introduced.

Farmer A and his staff have found very noticeable the benefit derived from electric workshop tools, such as drill, grinder and welder. This equipment cost in the first instance about £120, the annual equipment charge (Table 14) is put at £14 per year, and the electrical cost of running it is very low. The use of it involves labour, but this in fact is cowman's labour, made available by the improvements in his department: and labour is also likely to have been saved by prompt repairs and maintenance and useful new equipment made. On the basis of items of work done since the equipment was installed, it is estimated that saved expenditure for repair and constructional work has amounted to about £50 per year. To this are to be added the less certain but probable advantages of a more fully equipped workshop, which may lead to increased output by way of repair jobs promptly done; and saving in purchase of new equipment, since the old is tolerable if it can be looked after.

The sum of the indirect benefits upon which it has been felt possible to put a value is thus a little over £200.

Farm B

A standard result for this farm would be as follows:—

TABLE 15

Input, Output and Investment (B)

Input	£	*Output*	£
Labour	1,600	Crops	1,200
Concentrates	5,300	Milk	3,400
Power	1,300	Cattle, Sheep	1,900
Other	2,200	Pigs	5,700
		Sundry	200
Total	10,400		12,400
Profit	2,000		

Tenant's Capital £9,800

Against this background, the direct financial results may be seen in perspective. They are summarised in the next Table.

TABLE 16

Direct Consequences, Farm B (£)

	Annual Equipment		Fuel or Energy		Average Investment		Labour (hours)	
	—	+	—	+	—	+	—	+
Milker	34	6	13	7	20	28	—	—
Water Heater	—	2	15	14	—	15	70	—
Mill, Mixer	72	43	7	12	70	190	210	70
Infra-Red	3	9	10	43	5	16	130	—
Buildings, Wiring & Lighting	(2)	2	(1)	1	—	46	—	—
	61	62	46	77	95	295	410	70

These figures are mainly drawn from the foregoing analysis of the individual applications. The tractor cost of driving the former mill is roughly divided into its fuel and repair constituents, depreciation being excluded, since in the main it does not vary with use of the tractor. Unlike the case of Farm A, where most of the lighting wiring of the buildings was already done, this was entirely new electrification. At this farm the scattered buildings meant a large amount of overhead distribution which makes the total wiring cost nearly £140. From this one-third grant is deducted, and as an average investment, it is entered in the Table at half the initial cost. The annual cost of general wiring like this is put at one-fortieth of initial cost, and estimates are inserted of the cost of light bulbs and of former oil lighting.

Here again the direct financial results, when seen against the background of the farm's economy, are very small indeed. The "power" group of farm costs rises by a negligible sum, the level of investment is £200 higher on a total of about £10,000, and even the initial money to be found at the time of the change, at some £600, is not very significant in relation to the whole farm business.

The total labour effect as computed in the Table is evidently such as to make itself felt in the running of the farm, but a good deal less likely than at Farm A to lead to measurable changes in farm costs. A fair proportion of it represents a saving in work and worry for the farmer himself and unpleasant chores for his wife.

Indirect Consequences, Farm B

Possibly the most notable consequence of these changes on this farm would be through the effect of a satisfactory infra-red heating system on pig output. The system of heating by pressure lamps, as described in detail by the farmer, was barely a practicable one, with a fire risk, a risk of being put out by moderate draughts, and a consequent restriction of possible siting that severely limited its usefulness. Therefore the advantage of heating may be reasonably ascribed to electricity supply.

How great is this advantage? The farmer has said that it saves two piglets per litter. This, being equivalent to total normal mortality, seems too high an estimate to use when computing a change that can reasonably be expected to have been due to infra-red alone. If the more conservative improvement of 10 per cent in weaned litter average is postulated, then a normal pig enterprise of the type at Farm A and of the size at Farm B would expect to benefit to the extent of nearly £200. The pigs at Farm B are in fact sold to quite an extent (one-third) in the form of breeding stock, some with litters. The advantage of larger litters in this type of enterprise is likely to be greater than in fat pig production: but the difference defies useful calculation.

Several of the installations on this farm involve a change to easier and pleasanter methods of work, quite apart from any saving in time that has to be paid for. Mobile petrol driven milkers produce noise and smell, unwelcome in the cowshed. The electric water heater provides ample hot water on tap with no trouble at all, in place of a limited amount in a copper after lighting and stoking a fire. It is not possible to calculate an exact value for preferred methods as such. Possible bases for a rough monetary estimation, which would be better than nothing, might be, in the case of farmer's or wife's work, "equivalent consumer satisfaction", or what they would normally be ready to pay for a "comparable amenity". In the case of hired labour, the criterion could be the wage incentive needed to take a post, otherwise identical, when the less professed method was followed. It would be difficult to put the value of the above two amounts at less than say £25 per year.

The larger quantity of hot water may be expected to increase the effectiveness of production in ways that may well show up in the long run, in one form or another, on the farm account. Rejection of milk might be avoided, due to better cleaning of utensils; or, perhaps, a more probable but even less calculable effect, the standard of cowmanship on the farm might be higher than with the old arrangements. These possibilities seem to be such that no figure of prospective financial advantage could be put upon them, beyond pointing out that since £3,500 worth of milk is sold annually, there is the possibility of any improvement in this department amounting to a worthwhile sum.

One side-effect of the milling and mixing plant is the freeing of the tractor which used to drive the mill. The importance of this depends on the extent to which milling could be done when there was a tractor spare. Since it was needed for only about 1½ hours weekly, one may suppose that it usually could. But this aspect is likely to have an influence on the amount of home mixing that was done with the old equipment.

To date, very little more feed has been prepared on the farm than was prepared before, in spite of the capacity of the new plant, its ease of automatic operation and the probably more effective mixing. Of the £5,300 worth, or 200 tons, of concentrate, about one-sixth was and is home ground, and two-fifths home mixed. It seems reasonable to estimate that a farmer might be expected in the long run, taking one year with another, to take advantage of such a plant by preparing more feed at home than before. If the cost advantage of providing equivalent feeding value in this way, as compared with compounds, is put conservatively at £1 per ton, and the tonnage ground and mixed is reckoned to increase by 50 per cent, there is a saving of £40 . Twice this cost saving and twice this quantity increase are perhaps more probable figures, which would produce four times the stated total saving. This is just a way of saying that where feed is used on the scale of this farm, good facilities for home preparation can be confidently expected to pay.

Finally there is to be installed as part of the scheme on this farm a pressure pump to supply water to certain fields which lack it. The pump (at £250) piping and so on will cost about £500 in all, and the annual equipment cost (depreciation and maintenance) is estimated at £46. The water that is used in these fields is unlikely to exceed 100,000 gallons, which means a cost per thousand of nine shillings, plus about fourpence for electrical energy. This does not compare favourably with using the present farm supply of metered water at 4/– per thousand for those fields, plus piping at say £20 per year. But as it happens this present supply is limited in quantity, and cannot be used for those fields. This is an example of the added flexibility which comes to a farm when electric power is available.

The disadvantage of not having water in these fields is considerable, affecting the rotation that can be planned, possibly the number of cows that can be kept, and certainly the period of the day for which the herd can be left to graze continuously there without risking a fall in production. Taking this last kind of effect as being the most certain and recalling that the value of summer milk produced is in the region of £2,000 it is clear that the annual cost of the water is likely to be more than repaid.

If, these admittedly speculative, but certainly conservative, estimations of probable indirect benefit are added together they amount to over £250.

Farm C

Following is the computed standard result for this farm.

TABLE 17

Input, Output and Investment (C)

Input	£	*Output*	£
Labour	2,600	Cereals	2,300
Concentrates	1,800	Potatoes	2,500
Power	1,900	Milk	4,400
Other	2,700	Cattle, Sheep	1,800
		Sundry	500
Total	9,000		11,500
Profit	2,500		

Tenant's Capital £9,000

The direct financial results are summarised in Table 18.

TABLE 18

Direct Consequences, (£) Farm C

	Annual Equipment		Fuel or Energy		Average Investment		Labour (hours)	
	—	+	—	+	—	+	—	+
Milker . . .	8	6	54	7	12	28		
Water Heater .	1	3	26	21	4	16		
Water Pump . .	6	6	58	12	18	29		
Mill, Mixer . .	—	55	115*	6	—	240	50	50
Dryer . . .	—	44	60*	40	—	200		
Buildings, Wiring and Lighting .	—	1	—	1	—	16		
Generator . .	20	—	29	—	80	—		
Total . . .	35	115	342	87	114	529	50	50

*Former contract charges. These would be included in the "power" section of farm costs.

In this case there are some sources of substantial saving associated with the change to public electricity, and expenditure under the headings of fuel, energy and contractor services is reduced overall by about £250. When annual charges for equipment are set against this, it becomes a net annual gain of £170, or about 9 per cent of power costs and 7 per cent of standard profits. The level of investment has risen by some £400; but, mainly because expensive contractors' charges are replaced by the operation of farm equipment, there is a sufficient advantage on a direct cash basis to justify this.

Indirect Consequences, Farm C

The only source of substantial "side-effect" on this farm is the crop dryer. Even here the advantages are not easy to estimate quantitatively. About twelve tons of artificially-dried hay were made in 1960. The quality was found to be so strikingly good that more may be made annually in future. Taking 12 tons as normal, however, what financial value can be put on the superior quality? Such estimates are sometimes based on starch or protein content, or on nutrient loss reduction. No such data for this hay are available. Scientific knowledge of animal nutrition is so incomplete, however, that economic interpretation of it would be highly uncertain; and a rough estimation of minimum advantage may reasonably be made based on farmer's reaction and observation of feeding results. If hay is usually valued in the market at £10 per ton, and compound cake at £30, it is probably not too much, in view of the normal variations in market price according to quality to put the value of this hay at £5 more, or one-quarter of the way to the value of cake. Checking this another way, in the light of a milk and cattle output of £5,600 and a concentrate cost of £1,800, it is very probable that the improvement of about a quarter of the hay made on the farm would benefit the economy to the extent of our estimate of £60.

As regards grain-drying, it has been said above that these facilities should, in various ways, lead to increased output. Harvesting can be done when it would not otherwise have been done: improved timeliness of the whole harvest should be possible. It will be possible to store and sell in dry condition grain which might otherwise have had to go immediately at a lower price, subject to drying. It is clearly impossible to put any precise figure on the economic advantage that is reaped in ways like this. There could even, on occasion, with ill luck or management, be economic disadvantage. However, subject to all such qualifications, and in the light of total grain output of £2,300, let us say that the gain could be expected to average not less than about 2 per cent of this, namely £50. This is a very low guess, but so much a guess that it is necessary to be conservative.

The mill and mixer are used to replace feed preparation off the farm by a merchant. No productive advantage can be expected unless the amount of home-prepared feed were to be expanded.

The provision of hot water for the dairy on tap, instead of in a boiler from which it must be carried, with consequent 50% increase in the quantity of water used, must certainly be listed as a productive advantage, as on Farm B, but one whose appearance on the farm account is problematical.

This equipment, replacing gas, and also the milking machine and water pump motors, replacing petrol, effect a considerable saving of trouble or attention required. This is particularly the case with the water pump, where the old noisy pump, when started, would continue for some hours and finally was turned off when overflow was noticed. The automatic electric pump, provided with float switches for filling the various tanks, clearly removes a complication and embarrasment from life at this farm. If only it were possible to make such a calculation, it might well turn out that the improved capacity of the farmer to look after the farm would contribute substantially to his profit. On an amenity value basis (see Farm A) £20 seems a reasonable estimate.

The sum of these estimates on Farm C is £130.

Farm D

Estimated on a standard basis, the economic picture of this Cornish stockrearing farm with pigs and poultry appears as follows.

TABLE 19

Input, Output and Investment (D)

Input	£	*Output*	£
Labour	1,600	Cereals	1,600
Concentrates	3,700	Cattle, Sheep	3,100
Power	800	Pigs	1,600
Other	1,300	Poultry	2,600
		Sundry	200
Total	7,400		9,100
Profit	1,700		

Tenant's Capital £7,500

The changes associated with the introduction of electricity had the following total effect, so far as the immediately measurable results are concerned.

TABLE 20

Direct Consequences, Farm D (£)

	Annual Equip- ment		Fuel or Energy		Average Invest- ment		Labour (hours)	
	–	+	–	+	–	+	–	+
Water Pump		2		2		8	150	
Mill, Mixer		49	112*	5		210	90	20
Dryer		37	100*	56		160		
Infra-Red		6		22		10		
Poultry Lighting	4	2	15	6	17	8	90	
Buildings, Wiring and Lighting	(2)	2	(1)	1		13		
Total	6	98	228	92	17	409	330	20

*Former contract charges.

Here it is almost entirely a matter of additional costs of equipment and of power to run it, amounting on an annual basis to nearly £200, approximately counterbalanced by the saving of contractors' charges for some of the work, which was formerly done by them. The farm's standard "power" costs, which are relatively low on this type of farm, are very little altered. The effect of the additional £400 on the average level of investment amounts to a 5 per cent rise only. The farmer's capital on this farm is invested very largely in livestock: the addition to the investment in equipment would be a substantial proportion; perhaps 30 per cent. It is to be remembered that the equipment is entered in the Table at half its initial cost: so that the immediate effect of this change on the money laid out on the farm's equipment is a relatively great one. The saving of 300 hours of labour does not look very significant: but it may be noted that the two regular daily jobs saved—water pumping and poultry lighting—had an appreciable nuisance value.

Indirect Consequences, Farm D

This farm is in a state of evolution, with a policy still developing towards the system which the farmer would like, at a rate determined by the capital, buildings and equipment that can be built up. This means an added difficulty is assessing the electrical contribution to production: it also means ultimately greater scope for that contribution, and it may be expected to mean more than average openmindedness to new techniques, and readiness to make adaptations and take fullest advantage of facilities.

Thus the dryer which was installed, similar to that at Farm C, is less likely to be of profit for grain, not only because less grain is grown, but because it is intended to reduce it still further. On the other hand, the plant may well be used to its maximum for drying hay. If the probable quantity is 25 tons then the benefit, at the rate used for calculation at Farm C, would be £125. The farmer is aiming to make even more hay than this.

The pig enterprise, again, where infra-red heating has been introduced, is in process of rapid expansion. It is reported that no deaths have occurred since the heating was installed. This might well mean an improvement of 20 per cent in litter average, similar to that alleged by Farmer B. However, adhering to the more conservative estimate of 10 per cent, the gain on the pigs as they were in 1960 would be £40, and would be greater as the pig numbers increase.

In the case of milling and mixing, considerations apply similar to those at Farm B, where there is a heavy use of concentrates on the farm. Here, total usage in 1960 was 134 tons, of which 45 tons were home ground, 56 tons home mixed. The advantages and drawbacks of home feed preparation will be carefully weighed up by this farmer. His new equipment gives him the opportunity, should he so wish, to prepare any quantity he is likely to need: and the greater preponderance of pigs on the farm makes more home milling increasingly probable. It seems fair to use at least the same "improvement figure" as was calculated for Farm B, namely £40.

The electric lighting of deep-litter hens, it will be remembered, was in replacement of less bright and uniform and more troublesome lighting by gas. Some production advantage might well be expected, but not enough is known of the effects of different amounts of light, at least on these birds, to place reliance on any calculation of it. The poultry, as Table 19, shows, are a major enterprise on the farm.

The total of the estimated indirect advantages thus amounts to about £290.

Summary

Looking at the general effect on the economy of the farms, it is notable that even on these farms where a maximum economic use has been made of electrical energy, the amount which the Board is able to sell (which is, in a sense, its object) is relatively small in value, ranging from £77 to £124 per annum and averaging £95 or about 9/– per acre, and 6 per cent of total "power" costs.

The total estimated annual charges of the equipment that was installed at the same time was a little greater, at £118 per farm.

The total costs directly avoided, both of the equipment and running and including contractors' charges amounted on average to £233 per farm, so that on balance the ascertainable effect on farm costs over the four farms has been quite negligible.

On three of the farms there was an appreciable saving of work requirement, averaging (over all four) about 500 hours per farm per year, or a fifth of a man's time on each. At the current hourly cost of labour the value of this would be about £100 per farm, and it would amount to about 5 per cent of the total labour used. While this cannot of course be quoted as cost saved, the probable effects on the farm economies have been discussed and there is no reason to suppose that in the long run the advantage of the labour saving will be less than this.

Finally, some very uncertain estimates have been made of the more indirect effects of these changes on the farms' economic results and the farmers' welfare. As precise indivdual figures, these are advanced with all due caution; but as indications, calculated on a very conservative basis, they can in sum be treated as sound. The average of these is in the region of £200 per farm.

The average value over the years of the additional equipment put in, over and above that of equipment replaced, was £430 per farm or a 5 per cent rise in farmer's investment. The initial capital cost to the farmers, with no allowance for the old equipment replaced (little was sold) averaged £1,060 on each farm.

The estimated direct cash return on this investment, after allowance has been made for depreciation and maintenance of the equipment, is approximately nil. The depreciation and maintenance rates used in the calculation are largely arbitrary; but no reasonable alteration of them would make the effect great.

On the other hand, use of this electrically-powered equipment is likely to make a worthwhile contribution to the ease of running these farms and to their productivity. The probable cash value of advantages of this kind represents a good return on the initial cost of the change.

The question, what (if any) other, non-electric, means could have been used to achieve similar ends, has not been considered. This is a study of what is actually happening. And what is happening on these farms is typical of what is happening to agriculture. Electricity is spreading steadily until it is available on a very large percentage of agricultural holdings. There is no question of going back, in view of the many parts it has to play in the development of farming as a modern industry and a vocation attractive to modern people.

Joseph Cook & Son (Printers) Ltd., 99 Lower Ashley Road, Bristol 2