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Hay dries 0.8.

WEST OF SCOTLAND AGRICULTURAL COLLEGE  
ECONOMICS DEPARTMENT

Report No. 5 - 1950

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Grass drying in 1949

by

C.W. Roberts

Economics Department,  
West of Scotland Agricultural College,  
6, Blythswood Square,  
Glasgow C.2.

1.  
SUMMARY

The information in this report relates chiefly to five grass drying plants in the South-West of Scotland in 1949, all in either their first or second year of operation.

Capital costs specifically incurred for grass cutting, collecting, transporting and drying varied from about £6 to £30 per ton of rated seasonal capacity.

Actual output varied from 11% to 57% of this seasonal capacity. Shortage of grass due to the dry summer of 1949 was the chief cause of the low total output.

Fuel costs per ton of dried grass varied from £4.11s. to £5.16s. and from 12% below the nominal requirements for normal moisture content to 177% above those requirements. The high figures could be largely explained by abnormal moisture content of the raw material.

Depreciation of driers and accessory plant and buildings varied from £3.11s. to £9.12s. per ton: and, including cutting, collecting and transporting equipment, total depreciation varied from £4. 3s. to £9.19s. per ton. All these figures are gross, before deducting any Government grants towards the purchase and erection of the plants.

Total costs incurred by the grower and the owner of the drier for all stages from cutting the grass to delivering back the product, including a share of farm overhead costs, varied from £16.12s. to £29. 4s. per ton of dried grass.

Average yields per acre, counting one acre mown twice as two acres, varied from 11 $\frac{1}{2}$  cwts. to 22 $\frac{1}{2}$  cwts. Yields from individual fields and farms varied much more.

If the costs of growing the grass are put at £4. 3s. per ton of the product and the cutting, collecting and drying costs per ton from each of the plants <sup>are</sup> averaged the total costs of producing, drying and delivering the dried grass may be said to have amounted to £27. 1s. a ton.

Costs should be lower in seasons of fuller supplies of grass.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made of the information and help readily given by the owners and staffs of the grass drying plants of which particulars are reproduced in this report, and of the general information which individual farmers gave. Some of the investigational work was done by Miss H.C. McIver of this Department.

INTRODUCTION

Having its farming based on a high proportion of rotational grass to permanent grass and a relatively high rainfall the College Province presents some problems in grass drying which are less troublesome in eastern districts; but it also normally offers the prospect of abundant and continuous growth of good quality grass. In the 1949 season with which this report is concerned and in which this Department first attempted to collect information about grass drying in the district, there occurred a prolonged drought in early summer. Under the circumstances it was not surprising that all the five grass drying plants from which information was supplied to this Department, failed to achieve the output and level of efficiency which had been hoped for. Nevertheless they all turned out supplies of a product which was very welcome in the winter of 1949/50.

The following notes summarize the information about outlays and output. Some plants provided details about the costs of establishing the leas and the subsequent cultivations; but these have been omitted from this report.

TYPES OF PLANT, AND CAPITAL COSTSThe organization of the plants.

Two of the plants were owned by Farmers' Co-operative Societies, one chiefly a requisites society, and the other a society specially formed to acquire and run a grass-drier; two by Estates rather than single farms; and one by a large farm.

Three had Templewood (conveyor) machines; one had two Kennedy and Kemp (conveyor) machines; one had an I.C.I. (tray) machine; and one had an Opperman (tray) machine. Another I.C.I. tray drier was used on contract in conjunction with the Kennedy and Kemp machines but details of outlays were not recorded. All except the I.C.I. driers were oil-fired.

In addition to information from the five drying plants, details of cutting and collecting were provided by a sixth undertaking.

Some details about the age and output of the plants are given in the table.

Throughout the report weights refer to the weight of dried grass produced, except where the context clearly implies something else. The terms "nominal annual capacity", and "nominal capacity" have been used in this report for the tonnage that would have been dried in the season if the machines had worked 1500 hours and had maintained the hourly output rated by the manufacturers or others.

Organization and Output

| <u>Type of Owner</u> | <u>Type of Plant</u>     | Year<br>of<br>first<br>use. | Estimated<br>capacity in<br>1500 hrs.<br>(tons) | Actual<br>Output<br>1949<br>(tons) | Actual<br>Output<br>as % of<br>estimated<br>capacity<br>% |
|----------------------|--------------------------|-----------------------------|---|------------------------------------|---|
| A Estate.            | Templewood               | 1948                        | 300   | 160                                | 53  |
| B Estate.            | Templewood<br>and I.C.I. | (1949<br>(1948              | 600   | 341                                | 57  |
| C Society.           | Templewood               | 1949                        | 300   | 172                                | 57  |
| D Society.           | Kennedy & Kemp           | 1948                        | 300   | 83 x                               | 28  |
| E Farm.              | Opperman                 | 1949                        | 300<br><u>1800</u>                              | 33<br><u>789</u>                   | 11<br><u>44</u>   |

x In addition this Society arranged for the drying of 218 tons by contract on an I.C.I. drier.

All operators were disappointed with the low volume of output for the season, the chief reason for which was the general shortage of summer grass resulting from the drought of June and July.

### The Equipment

- (1) The fixed equipment. The table shows the original cost of the driers and any special building work required.

|                                    | <u>Original cost of fixed equipment (£)</u> |              |             |             |             |
|------------------------------------|---|--------------|-------------|-------------|-------------|
|                                    | A.  | B.           | C.          | D.          | E.          |
| Buildings & foundations & wiring   | 893   | 5470         | 3173        | 1695        | -           |
| Drying plant & balers, mills, etc. | <u>2446</u>                                 | <u>5055</u>  | <u>4736</u> | <u>3365</u> | <u>1523</u> |
| Total, fixed equipment             | <u>3338</u>                                 | <u>10525</u> | <u>7909</u> | <u>5060</u> | <u>1523</u> |

The same per ton of nominal annual capacity      £11.2s. £17.10s. £26.6s. £16.18s. £5.2s.

- (2) Cutting and Collecting Equipment.

The table shows the costs of equipment for cutting and collecting and transporting. In the case of C the figures cover the whole of the collecting and transporting equipment used by the plant, but the cutting equipment is omitted since cutting was performed by the farmers. At D the lorries used are not included since they were charged for on a hiring basis; the cutting was done by farmers. The lists for A, B and E include all the equipment used for cutting, collecting and transporting grass for drying; it was sometimes used on those farms for silage and hay making as well as for grass drying. Tractors are omitted throughout.

### Original cost of cutting, collecting and transporting equipment.

|  | A.  |            | B.  |             | C.  |            | D.  |            | E.  |            |
|--|-----|------------|-----|-------------|-----|------------|-----|------------|-----|------------|
|  | No. | £          | No. | £           | No. | £          | No. | £          | No. | £          |
| Mower  | -   | -          | 4   | 304         | -   | -          | -   | -          | 1   | 65         |
| Outlift  | 3   | 485        | 1   | 276         | -   | -          | -   | -          | -   | -          |
| Pick up  | -   | -          | 4   | 580         | 2   | 345        | 3   | 480        | 1   | 175        |
| Trailers   | 2   | 88         | 3   | 321         | -   | -          | -   | -          | 1   | 76         |
| Lorries  | -   | -          | -   | -           | 2   | 550        | x   |            |     |            |
| Rake, etc.   |     |            | 2   | 103         |     |            |     | 8          | 1   | 8          |
| Total of these:                                      |     | <u>573</u> |     | <u>1584</u> |     | <u>895</u> |     | <u>488</u> |     | <u>324</u> |
| The same, per ton of nominal annual output of drier, |     | £1.18s.    |     | £2.12s.     |     | £3.0s.     |     | £0.16s.    |     | £1.2s.     |

Per ton of nominal annual capacity, the two groups of equipment specially acquired for grass drying together cost:-

|                        | <u>Per ton of nominal annual capacity</u> |             |             |              |            |
|------------------------|---|-------------|-------------|--------------|------------|
|                        | A.  | B.          | C.          | D.           | E.         |
|                        | £.s.                                      | £.s.        | £.s.        | £.s.         | £.s.       |
| Fixed equipment        | 11.2                                      | 17.12       | 26.6        | 16.18        | 5.2        |
| Field & road equipment | <u>1.18</u>                               | <u>2.12</u> | <u>3.0</u>  | <u>- .16</u> | <u>1.2</u> |
|                        | <u>13.0</u>                               | <u>20.4</u> | <u>29.6</u> | <u>17.14</u> | <u>6.4</u> |

### DEPRECIATION CHARGES

Bearing in mind the possibility that future advances in design may offer such advantages that the operators of these plants may find it desirable to incur substantial additional expenditure to install those improvements, it has been thought well to use heavy rates of depreciation in these calculations. These rates, then, include an allowance for obsolescence.

For grass driers and accessories the rates used have been based on 25% of written down value; and for cutting and collecting equipment, except trailers (12½% - 15%) the same rate has been used; buildings have been depreciated by 10%. These rates may be nearly twice as high as necessary. On a full year's nominal output these charges would amount to the following in a first year.

|                          | <u>Total depreciation in first year per ton</u> |                |                |                     |                |
|--------------------------|---|----------------|----------------|---------------------|----------------|
|                          | A.  | B.             | C.             | D.                  | E.             |
| Field and road equipment | £-. 9s.   | £-.11s.        | £-.15s.        | £-.4s. <sup>x</sup> | £-. 4s.        |
| Fixed equipment          | 2.12s.  | 3. 0s.         | 5. 0s.         | 3.7s.               | 1. 6s.         |
| Total of these           | <u>£3. 1s.</u>                                  | <u>£3.11s.</u> | <u>£5.15s.</u> | <u>£3.11s.</u>      | <u>£1.10s.</u> |

If the depreciation charges are reckoned, as is usual, on a time basis, the only way of keeping depreciation per ton down is to increase the tonnage produced; but in fact, if a plant is likely to be worn out by handling a given total output, and if the plant is very well protected from decay, the time depreciation in any year will be bigger the greater the tonnage handled. Under these circumstances the only saving of depreciation which results from increasing the output in any year is that which follows from spreading the allowance for obsolescence over a bigger quantity. Low depreciation charges per ton result from high annual output, good maintenance and a long life.

The relatively small charges for the depreciation of field and road equipment, big as they may be per ton will be reduced if the equipment is used for other purposes such as silage making; here again, however, given good attention to maintenance and assuming relatively low risks of obsolescence, decreases in true cost per ton will not be proportionate to the tonnage handled.

In this report however, depreciation charges for the season have been reckoned purely on a time basis.

On average these depreciation rates per ton would have been more than doubled because of 'unused capacity' had all the equipment been less than a year old. The method of depreciating on the basis of a written down value of course, brings the total depreciation down year by year.

#### CUTTING AND COLLECTING

In order to make this section cover all the expenses of cutting, collecting and bringing in the green grass, whether performed by the owner of the drier, the member of the society, or the farmer-owner of the drier, estimates have been made of the time taken in mowing the grass (where this was not done by the owner of the drier); the time of the farm men helping in the loading and transporting has also been allowed for.

The table shows the chief equipment used for loading and transporting. It does not include mowers, small tools and ancillary appliances like rakes. The average distance from field to plant is also stated.

| <u>Plant</u> | <u>Equipment</u>                                       | <u>Approx.av. Radius(miles)</u> |
|--------------|--|---------------------------------|
| A.           | Cutlifts and trailers                                  | 1½                              |
| B.           | 1 Cutlift, 4 Greencrop loaders and trailers            | 2                               |
| C.           | Greencrop loaders and lorries                          | 8                               |
| D.           | ditto. ditto.  | 12                              |
| E.           | (Greencrop loaders and trailers<br>(Some hand-loading) | ¾                               |
| F.           | Greencrop loaders and trailers                         | 2½                              |

As would be expected, plants C and D which used lorries over long distances, incurred heavier expenditure per ton than did the estate plants A and B. The average/

<sup>x</sup>The annual capacity includes that of the drier employed on contract.

average loads carried were respectively equivalent to 11.3 cwts and 15.1 cwts of product. The figures suggest that, apart from drivers' wages, lorry loads cost approximately 1/- a road mile on C and about 1/11 on D. These amounts cover the non-paying runs shifting loaders etc and the run in the fields when actually loading. (These are probably approximately  $2\frac{1}{2}$  miles per ton of product). It seems that D was at a disadvantage with C, not only because its members were more scattered but also because the 'hiring' charge it had to bear for lorries was much higher. There were also difficulties of organization consequent on these big distances which contributed to the higher absorption of labour by D.

Table 1 in the appendix shows the individual costs per ton of cutting, loading and bringing in.

Overhead charges have been entered along the conventional lines agreed by the Conference of Scottish Agricultural Economists, in respect of all farm labour and tractors. They account, on average, for about 1 3/- per ton of product. Manual wages have been charged at normal rates, including overtime, and tractor work has been charged at 3/8 per hour.

The teams normally at work at any one time on collecting and bringing in were, in addition to men cutting when a cutlift was not used, as follows:-

|  | <u>Number of workers</u> |     |     |     |    |
|--|--------------------------|-----|-----|-----|----|
|  | A.                       | B.  | C.  | D.  | E. |
| <u>Collecting &amp; bringing in</u>                  |                          |     |     |     |    |
| Tractor or lorry driver                              | 1-2                      | 4   | 2   | 2-4 | 1  |
| Loader   | 1                        | 2   | 1-2 | 4-2 | 2  |
| Side raking  | -                        | 1   | -   | -   | -  |
| Corresponding numbers of workers at the drier were:- |                          |     |     |     |    |
| <u>Drier mill and baler</u>                          |                          |     |     |     |    |
| Supervisor   | 0-1                      | 0-1 | 0-1 | 0-1 | -  |
| Others   | 2                        | 4-5 | 2   | 3   | 2  |

While the driers were usually worked for 10 hours a day, or even 22 hours by means of shift arrangements, the collecting work was done in shorter periods of work by staff who had other duties. It would not, therefore, be correct to add together the numbers of workers indicated in the two parts of the table above, to give the numbers working at any one time.

Shift working and part-time working bring with them problems which none of these plants were able to solve without much thought; and scattered fields, break-downs and unexpected rates of growth often necessitated quick revision of daily or weekly plans.

#### DRYING

Details of cost are set out in Table 2.

Overhead charges have been entered here on the same principle as in Table 1. On average they account, with rent and insurance, and with office expenses and management charges in the case of the two Societies C and D, to 25/- per ton. The heaviest and most debatable item is depreciation, amounting to about £6-10s. per ton. It is higher than would be expected because of 'unused capacity' and in total, is higher than it would be say 3 years hence as the written down values of capital equipment decrease.

Fuel consumption and its reduction exercised the minds of those in charge. For a given plant the quantity used per ton of product may increase by roughly 50% as a result of an increase of 5 points in the moisture content above 80%. Without knowledge of the moisture content of the original grass it is thus impossible to estimate the fuel theoretically necessary.

The figures in the last line of Table 2 show how much more (or less, in the case of B) fuel was used per ton than would have been used if the manufacturers'/

manufacturers' standards had been achieved and the grass had been of normal moisture content, namely 80% in the fresh grass and 10% in the dried product. (See C.B. Chartres in the Proceedings of the Institution of British Agricultural Engineers, August 1948).

E was the only plant for which wilting was practised in this year. All recognized the possibilities of fuel economy to be gained from the process but on balance preferred to dry the freshly cut grass. C and D especially considered that difficulties of organizing and the risks of damage from a break-down in collecting arrangements would be increased by this practice.

#### TOTAL COSTS

If the cost of producing the grass, including a share of overhead expenses of roughly 11/- a ton is estimated at £4.3s a ton, and £4.16s. is added for cutting, collecting and bringing in and delivering back the product and £18.2s. is added for drying, the total cost per ton becomes £27.1s. From this can be deducted, for members of co-operative and other approved groups, the share of the Government grant which would pull down the depreciation by roughly one-third and would so lower these costs to about £24.12s. per ton.

Below, some figures for the English M.M.B. centres in the same season (Farmer and Stockbreeder, 14/3/50) are compared with figures from this report. The services covered are slightly different. They indicate that fuel prices and possibly fuel demands (especially in that coke is less expensive a unit of heat than oil) have been against these plants and that were depreciation either spread over a larger output or calculated at a lower rate the figures would not differ more than one would expect.

|                | <u>£. per ton</u> |                     |
|----------------|-------------------|---------------------|
|                | <u>M.M.B.</u>     | <u>These plants</u> |
| Wages          | 4.24              | 4.12                |
| Fuel           | 3.47              | 5.15                |
| Electricity    | 0.44              | 0.58                |
| Depreciation   | 3.07              | 7.29                |
| Total expenses | <u>17.36</u>      | <u>22.89</u>        |

#### THE QUALITY OF THE PRODUCT

The samples taken for analysis showed, as is usual, wide variations from field to field and from month to month; but the view that rate of growth is the chief determinant of protein content seems to have been supported.

The average protein content of first cuts on one plant was 14.0% (from 9.5 to 17.3). On another plant first cuts averaged 11.9% (from 6.6 to 17.0), second cuts averaged 14.1% (from 10.2 to 17.9) and third cuts 17.6% (14.6 to 10.7). Individual analyses for a third plant showed for May 10.6%, July 13.7% and September 15.7%.

While the available analyses do not cover all the grass dried by the five plants they are sufficient to show the scope for improvement still remaining, and, for one plant in particular, they have pointed out to the members ways by which to secure a higher quality product.

#### THE PLACE OF GRASS DRYING ON THE FARMS

In the cases of A and B, much of the dried grass was produced for sale. There, grassland was sown and managed with a view to the production of good, high protein grass, both for sale and for home use. Similarly E laid down special mixtures for drying.

The several farmer members of C and D, however, manured and dried whatever area of rotation or permanent grass they had ready and could spare from the demands of their grazing stock and the winter needs of hay; and persistence of the summer drought greatly reduced the amount they could spare. All used the product to good effect in winter and some determined to set aside specific fields for drying in 1950.



TABLE 1.

## Estimated costs of cutting, collecting &amp; bringing in; per ton

|  | A.    | B.               | C.              | D.              | E.               | F.              | Average          |
|--|-------|------------------|-----------------|-----------------|------------------|-----------------|------------------|
|  | £. s. | £. s.            | £. s.           | £. s.           | £. s.            | £. s.           | £. s.            |
| Manual work, (including lorry drivers) | 1. 3  | 1. 4             | 1. 7            | 2. -            | 1. 10            | 1. 9            | 1. 9             |
| Horse work                             | -     | -                | -               | -               | less than 1      | -               | -                |
| Tractor work                           | -. 19 | 1. 1             | -. 7            | -. 4            | 1. 10            | 1. 7            | -. 18            |
| Lorry work                             | -     | -                | 1. 15           | 3. 2            | -                | -               | -. 16            |
| Repairs and maintenance                | -. 1  | -. 4             | -               | -. 3            | -. 8             | -               | -. 3             |
| Depreciation                           | -. 11 | -. 11            | 1. 6            | -. 7            | 1. 7             | -. 11           | -. 16            |
| Management                             | -     | -                | -               | -. 9            | -                | -               | -. 1             |
| Share of general farm expenses         | 1. -  | -. 6             | -. 9            | -. 9            | -. 17            | -. 16           | -. 13            |
|  | 3. 14 | 3. 6             | 5. 4            | 6. 14           | 5. 13            | 4. 3            | 4. 16            |
| Manual hours                           | 10    | 10 $\frac{3}{4}$ | 9 $\frac{1}{2}$ | 17              | 13 $\frac{1}{4}$ | 13              | 12 $\frac{1}{4}$ |
| Horse hours                            | -     | -                | -               | -               | $\frac{1}{2}$    | -               | -                |
| Tractor hours                          | 5     | 5 $\frac{1}{2}$  | 2               | 1 $\frac{1}{4}$ | 8                | 7 $\frac{1}{4}$ | 5                |
| Lorry hours                            | -     | -                | n.a.            | 7 $\frac{1}{2}$ | -                | ..              | n.a.             |
| Total output (tons)                    | 160   | 341              | 172             | 301             | 33               | 100             | 184              |

TABLE 2.

Estimated costs of drying and milling or baling; per ton.

|   | A.   |    | B.   |    | C.               |    | D.               |    | E.               |    | Average |    |
|---|------|----|------|----|------------------|----|------------------|----|------------------|----|---------|----|
|   | £.   | s. | £.   | s. | £.               | s. | £.               | s. | £.               | s. | £.      | s. |
| Manual work   | 2.   | 11 | 2.   | 3  | 1.               | 6  | 3.               | 12 | 3.               | 14 | 2.      | 13 |
| Tractor work  | -    |    | -    |    | -                |    | -                |    | 2.               | 14 | -.      | 11 |
| Fuel oil  | 5.   | 7  | 3.   | 3  | 5.               | 5  | 4.               | 16 | 5.               | 16 | 4.      | 17 |
| Coke  | -    |    | 1.   | 8  | -                |    | -                |    | -                |    | -.      | 6  |
| Electricity   | -.   | 11 | -.   | 13 | 1.               | 2  | -.               | 11 | -                |    | -.      | 12 |
| Lubricants  | -    |    | -    |    | -.               | 1  | -.               | 2  | -.               | 1  | -.      | 1  |
| Wire, twine, bags, tags, etc.                                       | -.   | 4  | -.   | 11 | 1.               | 12 | -.               | 7  | -.               | 3  | -.      | 11 |
| Repairs, maintenance and small tools                                | -.   | 8  | -.   | 9  | -.               | 9  | -.               | 3  | 2.               | 1  | -.      | 14 |
| Depreciation  | 3.   | 11 | 4.   | 3  | 7.               | 12 | 9.               | 12 | 7.               | 12 | 6.      | 10 |
| Rent, insurance, office and management                              | -.   | 2  | -.   | 5  | 3.               | -  | -.               | 19 | -                |    | -.      | 17 |
| Share of general farm expenses                                      | -.   | 10 | -.   | 11 | -                |    | -                |    | 1.               | 10 | -.      | 10 |
| <u>Total</u>  | 13.  | 14 | 13.  | 6  | 20.              | 7  | 20.              | 2  | 23.              | 11 | 18.     | 2  |
| <u>Total including costs of cutting, collecting and bringing in</u> | 16.  | 18 | 16.  | 12 | 25.              | 11 | 26.              | 16 | 29.              | 4  | 22.     | 18 |
| Manual hours  | 15   |    | n.a. |    | 12 $\frac{1}{4}$ |    | 31 $\frac{1}{2}$ |    | 33 $\frac{1}{4}$ |    | 25      |    |
| Tractor hours   | -    |    | -    |    | -                |    | -                |    | 14 $\frac{3}{4}$ |    | 3       |    |
| Oil (gallons)   | 129  |    | 80   |    | 127              |    | 118              |    | 139              |    | 118     |    |
| Coke (cwts)   | -    |    | 9.3  |    | -                |    | -                |    | -                |    | 1.9     |    |
| Electricity (units)   | 68   |    | 124  |    | 147              |    | 49               |    | -                |    | 78      |    |
| Wt. of product per operating hour (cwts.)                           | 4.0  |    | 6.4  |    | 3.0              |    | 2.4              |    | 1.4              |    | 3.4     |    |
| " " " per acre mown (cwts.)   | 11.2 |    | 12.6 |    | 13.5             |    | 22.2             |    | 12.2             |    | 14.3    |    |
| " " " baled : % of total  | 100  |    | 2    |    | 0                |    | 94               |    | 100              |    | -       |    |
| Fuel consumption per ton : % of normal for the machine              | 119  |    | 152  |    | 88               |    | 117              |    | 277              |    | 151     |    |