COSTS OF TURNIP PRODUCTION
IN THE EAST OF SCOTLAND
1960 CROP

by

J. A. MACLENNAN, B.Sc.

THE EDINBURGH SCHOOL OF AGRICULTURE
WEST MAINS ROAD
EDINBURGH 9
COSTS OF TURNIP PRODUCTION
IN THE EAST OF SCOTLAND
1960 CROP

by

J. A. MACLEAN, B.Sc.
DEPARTMENT OF ECONOMICS

STAFF

J. D. NUTT, B.A., N.D.A.
B. PEART, B.A.
D. M. R. LEASK, B.Sc.
W. B. DUTHIE, B.Sc.
J. A. MACLENNAN, B.Sc.
J. D. HOGGBOTTOM, B.Sc.
A. BLYTH, M.A.
Miss I. E. G. MACKINTOSH, M.A.
Mrs. E. SMITH, M.A., Dip.Ag. Sci.
P. C. MARTIN, B.Sc. Dip.Ag.

Publications

A. Annual Reports on Financial Results of East of Scotland Farms:

- Hill Sheep Farms
- Stock Rearing Farms
- Stock Raising and Feeding Farms
- Arable Farms
- Dairy Farms

Reports for the years 1948-49 to 1959-60

B. Enterprise Studies:

- Milk Production (Annual Reports)
- Commercial Egg Production
- Pig Production
- Cattle, Potatoes and Sugar Beet Costs
- Etc.

C. Miscellaneous

- Piece-Work Potato Gathering
- Hill Farming During the Post-War Period
- Some Notes on Reseeding Old Grassland on Hill and Upland Farms, 1955-57
- Diesel Tractor Costs and Performance in the East of Scotland, 1956-57
- Some Notes on Grain Drying - 1957 Harvest
- Report on Grain Drying - 1958 Harvest
- Organisation of Hill and Upland Farming in Selkirkshire
- Economic Aspects of Tractor Work, 1957-58
- Some Notes on the Depreciation and Repair Costs of Farm Machinery
- Hill and Upland Sheep Production Costs

Copies of these publications may be obtained on request to the Secretary of the College or the Advisory Economist.
There has been a good deal of discussion in recent years over the merits of the turnip crop compared with those of other crops which can be grown to provide winter keep for various classes of livestock. There can, of course, be no simple basis of comparison as there is a complex of requirements involved. There is the need to maintain or build up the fertility of the farm through the utilisation of dung for which the turnip crop provides a well established opportunity. There are problems of providing the required quantities of food ingredients and it may well be that the use of turnips or alternative crops calls for differences in livestock husbandry which are not always sufficiently clear to be easily adopted. A change from turnips to another feed crop will involve adjustments in the rotation and a redeployment of labour and power over the year. That there has been some change-over from turnips to other feed crops is shown by the considerable increases in the acreages of silage and hay over recent years, though the increase in livestock numbers must be partly responsible. The interesting point is that although the turnip acreage has declined, it has done so only at a rate of about two per cent per annum. There has, in fact, been no wholesale changeover.

The present report discusses the various aspects of the costs of growing the turnip crop and brings out, in particular, the significance of the mechanisation which is being developed in connection with the sowing and harvesting of this crop. This information on costs and labour and power requirements should be of considerable interest and value to farmers who wish to assess the overall position of this crop in the economy of their farms.

J. D. NUTT,
Advisory Economist.
COSTS OF TURNIP PRODUCTION, 1960

INTRODUCTION

The turnip crop has for long been important in the East of Scotland, not only as a cleaning crop, usually taken between two cereal crops but also one which provides a suitable opportunity for the application of the large quantities of dung, which are the result of the integration of cattle with arable farming. The crop is indeed an important part of the cycle of crop and livestock production, in which the fertility of the land is a basic consideration. On many farms turnips provide a considerable part of the ration for all classes of cattle and sheep, being regarded as an essential part of the feeding programme for breeding and feeding stock alike.

In recent years, however, the popularity of the turnip crop has tended to decrease, chiefly due, it would appear, to the increased use of grass silage for cattle feeding. The extent of this is indicated by an examination of the changes in the acreages of turnips and of grass mown for silage and for hay during the five years from 1956 to 1960 in the East of Scotland. These figures* show that although the acreage of grass mown for silage and hay increased by 15,851 acres and 2,067 acres, respectively, the acreage of turnips fell by 6,365 acres. The acreages of other succulents remained unchanged during this period.

Other factors which affected the popularity of the turnip crop may be mentioned. Foremost, perhaps, in view of the continually increasing wage rates in recent years, has been the relative difficulty of mechanising the cultivating and harvesting processes compared to what can be achieved with the silage crop. Despite the introduction of the precision seeder, much hand labour is still necessary. Another factor is the incidence of disease in the turnip crop. Such diseases as mildew, turnip fly and turnip rot can considerably reduce the yield per acre. Grass crops do not appear to be as susceptible to disease to the same extent.

During 1960 the conditions throughout the growing season were almost ideal for the turnip crop, with the result that it has been estimated that yields per acre were some 25% higher than usual. This, together with wet conditions at harvest time, meant some added difficulty in dealing with the final stages of handling the crop and, in many cases, presented problems in disposal. The fact that yields can vary so widely, placed more emphasis on costs per acre than on costs per ton.

The Sample

Altogether 30 farmers supplied records for 34 crops. Four of the farms were described as dairy arable farms and twelve as arable and feeding farms, both types being mainly on the more fertile soils. Thirteen were described as stock-rearing and feeding farms, mainly at the higher elevations and one farm was classified as a stock rearing farm.

The methods of growing and harvesting the crops varied widely. For example, 27 crops were sown by precision seeder, the remaining seven being non-precision sown. Dung was applied to 21 crops and 13 received no dung at all. Twenty-seven crops were harvested and stored (14 with the use of the turnip lifting machine) and seven were eaten off by sheep.

The total area costed was 608 acres and the average field size for the 34 crops, 17.9 acres. The twenty-seven fields harvested had an average size of 16.7 acres, totalling 450 acres. The seven crops on which the sheep were folded made up the remaining 158 acres and had an average field size of 22.6 acres.

Costa /

* D.A.F.S. December Returns.
Costs

For purposes of comparison, the crops can be divided into three main groups, 20 crops harvested and stored which received dung plus compound manures; seven harvested crops receiving compound manure only and seven eaten off by sheep, all receiving compound manures (one receiving dung in addition). The average costs per acre for each group are shown in Table I.

Comparing the cost per acre for the two groups in which the turnips were harvested and stored it may be seen that the total cost per acre for the group receiving dung was £5.17.10; this is £6.5.6 more than for the other group receiving no dung, which had total costs of £4.8.12.4 per acre. There was little appreciable variation in the individual costs of labour and power between the groups. As a result, the total cultivating costs for the group receiving dung was £10.6.15 per acre and for the group without dung, £10.14.1. The corresponding total harvesting costs per acre were £11.2.6.8 and £13.6.10 per acre respectively. The one item of cost which did show a big variation was the cost of manures. It may be seen that the group receiving dung had an additional charge of £719.8 per acre for this manure but only slightly lower costs for artificial manures and manurial residues. The manure costs for this group were higher by £7.4.11 per acre.

The average yield per acre for the higher cost group was 37 tons giving a cost per ton of £19.6. The average yield for the other group was 34 tons per acre and the cost per ton £18.8. Thus, although the group to which the dung was applied had higher total costs these were to a large extent compensated for by higher yields.

It may be noticed, as would be expected, that the total cost per acre for the group of crops eaten off by sheep was appreciably lower, amounting to £22.0.11 per acre. The yield was 33 tons per acre and the cost per ton 13s.6d. Thus the total costs per acre and per ton for this group were both less than half those for either of the harvested crops. The interest point to note about this group is the relatively low total cultivation costs per acre which was over £3 per acre less than for the other groups. This reduction in cost, as will be shown later, was mainly the result of three crops in the group having been sown at six inch intervals by precision seeder and singling was unnecessary.

The proportions of the individual items of cost in each of the three groups show that for the harvested crops receiving dung, manure cost, which was the largest item, amounted to 29.2%. On the other hand, for the group of harvested crops receiving compound manures only the total of harvesting costs was the largest single item, totalling 27.3%. Both these groups had fairly heavy total cultivating costs per acre, amounting to 18.6% and 22.1% respectively. The total of indirect costs or "overheads" for these groups accounted, on average, for about 25% of the total costs, which reflects the relatively large proportion of labour and power in the growing of this crop. In the group of crops eaten off by sheep and hence having no harvesting, the cultivation and manure costs both accounted for a greater share of total costs. Table I shows that the cultivating and manuring costs for this group amounted to 32.7% and 39% of total costs. It may also be noted that the total of such items as rent, seed and other costs (mainly the cost of sprays) accounted for only a relatively small proportion of total costs. These ranged from 4.5% to 5.8% for the different groups.

The extent to which precision seeders and turnip lifting machines were used in each of the groups is also shown in the table. It may be seen that while about 70% of the harvested crops were precision sown, all the crops in the group folded on by sheep were sown in this manner; this is an additional factor in reducing the total costs of production for this group. It may be seen that of the two groups of harvested crops those /
### TABLE I. AVERAGE COSTS PER ACRE

<table>
<thead>
<tr>
<th>No. of Costs</th>
<th>Crops Harvested and Stored</th>
<th>Crops Eaten off by Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dung Applied</td>
<td>No Dung Applied</td>
<td>One Crop Received Dung</td>
</tr>
<tr>
<td>Labour and Power</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tractor</td>
<td>£2:8:9</td>
<td>£2:6:11</td>
</tr>
<tr>
<td>Total Cultivations</td>
<td>£10:6:5</td>
<td>£10:14:1</td>
</tr>
<tr>
<td>Harvesting: Manual</td>
<td>£8:8:3</td>
<td>£9:7:8</td>
</tr>
<tr>
<td>Tractor</td>
<td>£3:18:5</td>
<td>£3:19:-</td>
</tr>
<tr>
<td>Depreciation of Special Equipment</td>
<td>£9:10:-</td>
<td>£7:8:-</td>
</tr>
<tr>
<td>Total Labour and Power</td>
<td>£23:2:11</td>
<td>£24:8:5</td>
</tr>
<tr>
<td>Other Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manures (Net): Dung</td>
<td>£7:19:8</td>
<td>£-:-:-</td>
</tr>
<tr>
<td>Artificials</td>
<td>£5:11:-</td>
<td>£6:-9</td>
</tr>
<tr>
<td>Residues</td>
<td>£2:10:1</td>
<td>£2:15:1</td>
</tr>
<tr>
<td>Seeds</td>
<td>£-8:-</td>
<td>£-7:6</td>
</tr>
<tr>
<td>Other Costs</td>
<td>£-3:11</td>
<td>£-8:-</td>
</tr>
<tr>
<td>Rent</td>
<td>£1:18:7</td>
<td>£1:15:7</td>
</tr>
<tr>
<td>Overheads</td>
<td>£15:3:8</td>
<td>£24:1</td>
</tr>
<tr>
<td>TOTAL COST PER ACRE</td>
<td>£54:17:10</td>
<td>£48:12:4</td>
</tr>
<tr>
<td>% Crops Sown by Precision Seeder</td>
<td>71%</td>
<td>70%</td>
</tr>
<tr>
<td>% Crops Lifted by Machine</td>
<td>55%</td>
<td>41%</td>
</tr>
</tbody>
</table>
those which received dung had a higher proportion of crops lifted by machine. This was largely responsible for the lower harvesting costs per acre for the group despite the yield being higher by three tons per acre (for further details of costs and other data of machine lifting see Table VII).

Range of Costs

As might be expected, in view of differences in soil, elevation, harvesting conditions and management generally, there were quite wide variations in the total costs per acre within each of the three groups. For the 20 harvested crops which received dung these ranged from £2.16:2 to £72:3:8 per acre; for the seven harvested crops receiving no dung, from £38:10:8 to £50:15:11; and for the seven crops folded on by sheep, from £16:9:11 to £31:2:10 per acre. The percentage distribution of the costs per acre for each group is shown in Table II.

<table>
<thead>
<tr>
<th>Costs per Acre</th>
<th>Crops Harvested and Stored</th>
<th>Crops Eaten off by Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dung Applied</td>
<td>No Dung Applied</td>
</tr>
<tr>
<td>£10 - £19.9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>£20 - £29.9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>£30 - £39.9</td>
<td>-</td>
<td>13</td>
</tr>
<tr>
<td>£40 - £49.9</td>
<td>20</td>
<td>58</td>
</tr>
<tr>
<td>£50 - £59.9</td>
<td>60</td>
<td>29</td>
</tr>
<tr>
<td>£60 - £69.9</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>£70 and over</td>
<td>5</td>
<td>-</td>
</tr>
</tbody>
</table>

The pattern of the distribution of the costs per acre is seen to be similar for the three groups, each having a single cost range accounting for about 60% of the total numbers with much smaller numbers in the ranges above and below these. In the case of the harvested crops receiving dung, maximum numbers were in the £50-£59.9 per acre cost range, for those harvested crops receiving compound manures only, in the £40-£49.9 per acre cost range and for those eaten off by sheep, in the £20-£29.9 per acre cost range. Under normal conditions of management etc., total costs per acre for each system of production could be expected to fall within these ranges of cost.

FACTORS AFFECTING COSTS

In view of the relatively high proportion of the total costs per acre involved in harvesting, it could be expected that total costs per acre would tend to vary with yields. It might also be expected that costs would tend to be lower for these groups in which most use was made of precision seeding and turnip lifting machines. Heavier applications of manures would tend to increase total costs per acre but the same need not apply to costs per ton if yields increased in proportion to manure costs. Reductions in cost might also follow if the acreages worked were big enough to facilitate economies arising from the scale of operations. The effects of these factors are examined in the following sections.

Yields and Costs /
Yields and Costs

The relation between yields and costs per acre is best illustrated by examining the costs per acre for the 20 harvested crops that were dunged (the largest group in the sample). In Table III the results have been arranged in groups according to the yield per acre.

### TABLE III. RELATION BETWEEN YIELD AND COSTS PER ACRE

<table>
<thead>
<tr>
<th>YIELD GROUPS</th>
<th>20 Crops, Dunged and Harvested</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30-32.9 Tons</td>
</tr>
<tr>
<td>Average Yield per Acre</td>
<td>31 Tons</td>
</tr>
<tr>
<td>No. of Crops</td>
<td>5</td>
</tr>
<tr>
<td>Cost per Acre</td>
<td>£ s. d.</td>
</tr>
<tr>
<td>Depreciation of Special Equipment</td>
<td>-: 8: -</td>
</tr>
<tr>
<td>Manures</td>
<td>12:18: 5</td>
</tr>
<tr>
<td>Rent and Sprays</td>
<td>2:11: 5</td>
</tr>
<tr>
<td>Total Cost per Acre</td>
<td>£52:11: 3</td>
</tr>
<tr>
<td>Average Cost per Ton</td>
<td>£1:13:10</td>
</tr>
<tr>
<td>% Crops Precision Sown</td>
<td>80%</td>
</tr>
<tr>
<td>% Crops Lifted by Machine</td>
<td>20%</td>
</tr>
</tbody>
</table>

The table shows that for a more or less progressive increase in yield from 31 Tons to 40 Tons per acre, total costs increased from £52:11:3 to £55:2:10 per acre. This increase in cost, however, was offset by a greater rate of increase in yields and the cost per ton dropped from £1:13:10 to £1:7:7.

Examination of the harvesting costs per acre shows the apparent anomaly of the highest yielding group (40 Tons) having slightly lower harvesting costs per acre than the lowest yielding group (31 Tons). While the relatively high harvesting costs per acre for the latter group was in some respects due to the adverse weather conditions during the harvesting of some of the fields, another factor undoubtedly was the much smaller use made of turnip lifting machines.

Manure Costs

It may be seen in Table III that the cost of manures was the only individual item of cost that increased progressively with yields (disregarding the two cases in the 33 tons to 35.9 tons group), increasing from £12:18:5 per acre in the lowest yield group to £17:5:10 per acre in the highest yield group. Incidentally, the greater manure costs for the highest yield group did not result in a drop in the yield per £1 manure cost compared to the corresponding figure for the lowest cost group, the yields being 2.3 tons and 2.4 tons respectively.

Did /
Did this relationship between increased yields and increased manure costs apply to all the groups? The data given in Table IV, which shows the yield per £1 manure cost at various levels of yields for the three groups, shows that this was more or less true for all the groups that were harvested and stored and to a lesser extent for the crops eaten off by sheep.

**TABLE IV. MANURE COSTS AND YIELDS PER ACRE**

<table>
<thead>
<tr>
<th>Crop Yield</th>
<th>20 Harvested Crops With Dung</th>
<th>7 Harvested Crops No Dung</th>
<th>7 Crops Eaten Off by Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons</td>
<td>Tons</td>
<td>Tons</td>
</tr>
<tr>
<td>Up to 32.9</td>
<td>2.4</td>
<td>4.1</td>
<td>4.1</td>
</tr>
<tr>
<td>33 - 35.9</td>
<td>2.0</td>
<td>3.9</td>
<td>2.8*</td>
</tr>
<tr>
<td>36 - 38.9</td>
<td>2.3</td>
<td>3.5</td>
<td>7.5</td>
</tr>
<tr>
<td>39 Tons and Over</td>
<td>2.3</td>
<td>4.2</td>
<td>4.6</td>
</tr>
</tbody>
</table>

* Includes one crop which also received dung

One interesting point brought out by this table is the markedly lower level of yield per £1 manures for the groups receiving dung (plus compound manures). Incidentally this reduction when dung is applied is not peculiar to the turnip crop, as a similar relationship was found for the potato crop in an investigation into the cost of growing this crop in 1954. It might be concluded that it would therefore be more profitable to grow crops without dung, the organic matter, so essential for soil fertility, being supplied by some other method such as green manuring. However, as already pointed out, dung is an important by-product of arable farming in this area and must be returned to the land, either to the turnip or to the potato crop, if the fertility of the soil is to be maintained; even if it means producing at a higher cost per acre and per ton than can be achieved without it.

**Field Size**

A grouping of the cultivating and harvesting costs per acre for the 27 harvested groups, according to the acreage grown showed that there was little or no relation between total labour and power costs and field size. For example, for the five fields up to 10 acres in size total labour and power costs amounted to £23:1:4 per acre, for the 14 fields between 10 acres and 20 acres in size the figure was £25:3:7 and for the eight over 20 acres was £21:1:7. Difficult conditions at harvesting were responsible for the increased costs of the crops in the middle sized group of fields. Under more uniform conditions it could be expected that the relationship between field size and costs per acre would be more clearly defined.

**Precision Sowing**

Altogether 27 of the crops were sown by precision seeder, twenty-three of which were singled by hand. Of the remaining four, three were not singled at all and one crop was thinned by machine. Although precision seeding slightly reduces the cost of seed per acre (about 2/3 lb. seed at 7s.6d. per lb. for precision seeding as against about 3 lb. at 3s.6d. per lb. for non-precision sown seed) the main saving from using the precision seeder is the reduction in the labour hours and costs per acre for singling. Table V gives a comparison of the labour hours and costs per acre in relation to the two methods of sowing.

**TABLE V.**
TABLE V. THINNING COSTS PER ACRE
PRECISION AND NON-PRECISION SOWN SEED

<table>
<thead>
<tr>
<th>Method of Sowing</th>
<th>No. of Crops</th>
<th>Labour Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision Sown</td>
<td>23</td>
<td>18.6</td>
</tr>
<tr>
<td>Non-Precision Sown</td>
<td>7</td>
<td>24.3</td>
</tr>
</tbody>
</table>

The number of hours per acre for thinning the crops sown by precision seeder was 18.6 hours and for those non-precision sown, 24.3 hours; a saving of 5.7 labour hours per acre worth £1:5:8. This represented valuable saving in time, especially when it is remembered that very often the time for thinning coincides with hay making.

Another advantage from using the precision seeder, especially when turnips are to be eaten off by sheep, is the possibility of sowing at sufficiently wide spacing in the row to avoid the necessity of thinning. Three of the crops eaten off by sheep were sown in this manner and it is of interest to compare the total labour and tractor hours and costs per acre for the secondary cultivations for these crops with those of the remaining four crops in this group which were also precision sown but required thinning (Table VI).

TABLE VI. SECONDARY CULTIVATIONS UNDER DIFFERENT SYSTEMS
LABOUR AND TRACTOR REQUIREMENTS PER ACRE

<table>
<thead>
<tr>
<th>Crops Eaten Off by Sheep</th>
<th>No. of Crops</th>
<th>Secondary Cultivations</th>
<th>Hours</th>
<th>Total Costs per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Labour</td>
<td>Tractor</td>
</tr>
<tr>
<td>THINNED</td>
<td>4</td>
<td>Inter-row Thinning</td>
<td>3.3</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hoeing and Spraying</td>
<td>14.9</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.6</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td>23.8</td>
<td>4.4</td>
</tr>
<tr>
<td>UNTHINNED</td>
<td>3</td>
<td>Inter-row</td>
<td>2.2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

The total labour time for the four crops that were thinned was 23.8 hours per acre and for the three unthinned crops, 2.2 hours (only inter-row cultivations were necessary). This is a saving of 21.6 hours per acre. The respective tractor times were 4.4 hours and 1.3 hours - a saving of 3.1 tractor hours per acre. On the costs side the difference was £5:10:5 per acre in favour of the unthinned crops and totalling £12:15s. for the average sized field for this group. Incidentally, the relatively small difference between the total labour and tractor hours for the unthinned crops indicates the extent to which it is possible to mechanise the growing of turnip crops that are to be eaten off by sheep.

Turnip Lifting by Machine

It has been mentioned earlier in the report that an appreciable saving in harvesting costs per acre had been made possible by the use of machines for topping and tailing the crop. The extent of the saving in labour /
labour and tractor hours per acre for the 14 crops lifted in this manner over the more conventional method of lifting by hand is shown in Table VII. The total harvesting cost per acre for each system is also shown.

**TABLE VII. HARVESTING UNDER DIFFERENT SYSTEMS**

<table>
<thead>
<tr>
<th>Method of Lifting</th>
<th>No. of Crops</th>
<th>Total Harvesting Time</th>
<th>Yield</th>
<th>Total Cost per Acre £ s. d.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Labour Hours</td>
<td>Tractor Hours</td>
<td>Tons</td>
</tr>
<tr>
<td>By Machine</td>
<td>14</td>
<td>32.7</td>
<td>17.6</td>
<td>38</td>
</tr>
<tr>
<td>By Hand</td>
<td>13</td>
<td>46.0</td>
<td>15.9</td>
<td>34</td>
</tr>
</tbody>
</table>

The total labour time for harvesting the 14 crops lifted by machine was 32.7 hours and the total tractor time, 17.6 hours. For the 13 crops lifted by hand the total labour time for harvesting was 46 hours and the tractor time 15.9 hours. Thus the total saving in labour time per acre by using the machine was 13.3 hours, this being achieved despite a higher average crop yield of 4 tons per acre. The increased tractor hours for the crops lifted by machine was to be expected and was greater by 1.7 hours per acre. The overall saving in cost amounted to £2:8:7 per acre.

**LABOUR AND POWER REQUIREMENTS PER ACRE**

Table VIII shows the labour and tractor hours per acre for the different operations performed in each of the three groups studied.

**TABLE VIII. AVERAGE LABOUR AND TRACTOR HOURS PER ACRE**

<table>
<thead>
<tr>
<th>Crops Harvested and Stored</th>
<th>Crops Eaten Off by Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dung</td>
<td>No Dung</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Carting and Spreading Dung</td>
<td>6.3</td>
</tr>
<tr>
<td>Ploughing and Cultivating</td>
<td>8.2</td>
</tr>
<tr>
<td>Applying Manures</td>
<td>1.0</td>
</tr>
<tr>
<td>Sowing Seeds</td>
<td>1.3</td>
</tr>
<tr>
<td>Total Primary Cultivations</td>
<td>16.8</td>
</tr>
<tr>
<td>Inter-row Cultivations</td>
<td>2.7</td>
</tr>
<tr>
<td>Thimming</td>
<td>18.7</td>
</tr>
<tr>
<td>Hand-hoeing and Spraying</td>
<td>3.2</td>
</tr>
<tr>
<td>Total Secondary Cultivations</td>
<td>24.6</td>
</tr>
<tr>
<td>Harvesting</td>
<td>37.5</td>
</tr>
<tr>
<td>Total Labour and Power</td>
<td>78.9</td>
</tr>
</tbody>
</table>

* Where contract work was done this was converted to equivalent labour and tractor hours per acre.
As may be seen there was little appreciable difference in the total labour time per acre for the two harvested groups, these being 78.9 hours for the group which received dung and 82.8 hours for the one without it. The former group, however, had a greater total tractor time per acre, 34.4 hours as against 25 hours for the latter. The total tractor and labour times for the crops eaten off by sheep, as could be expected, were very much lower, amounting to 24.9 hours and 11.0 hours respectively.

From an examination of the individual labour times in the harvested groups, it may be seen that the extra time for carting and spreading dung for the group that received this manure, amounting to 6.3 hours per acre, was more than offset by reduced hours for thinning and harvesting, less by 4.9 and 5.8 hours respectively. As both these groups had similar proportions of fields sown by precision seeder, the reduced time for thinning must have been due to such factors as better soil and climatic conditions. The reduced labour time for harvesting for the group receiving dung was undoubtedly due to the greater proportion of crops lifted by machine. In regard to the greater total number of tractor hours for this group, which amounted to 9.4 hours per acre, this was mainly due, not only to extra time for dung spreading (5.5 hours) but also to the extra tractor time in harvesting (2.6 hours) which was largely the result of the greater use of turnip lifting machines.

Examination of the data for the unharvested crops shows that, apart from the absence of harvesting time and the differences due to the limited carting and spreading of dung, it was in the labour time for thinning, which was fully less than half the average of the other two groups, that the biggest saving was made. As previously explained, this reduction in time was due both to the higher proportion of precision sown fields in this group, as well as to the number of fields that were unthinned.

**Acknowledgement**

Grateful acknowledgment is made of the help given by farmers who took part in the investigation and who supplied the various records and other information and who always gave the investigator considerate and courteous attention on the occasion of his visits.
SUMMARY

1. Thirty farmers supplied records for 34 crops, totalling 608 acres giving an average field size of 17.9 acres. Twenty-seven of the crops were harvested and seven were eaten off by sheep.

2. Twenty of the harvested crops which received dung and compound manures, yielded 37 tons per acre, had a total cost of £54:17:10 per acre and an average cost per ton of £1:9:6. The seven harvested crops receiving compound manure only, yielded 34 tons per acre, had a total cost of £18:12:4 per acre and a cost per ton of £1:8:8. For the seven crops eaten off by sheep the corresponding figures were £22:6:11 per acre, 33 tons and 13s.6d. per ton.

3. Costs per acre for the 20 harvested crops receiving dung and compound manure tended to increase with yields but at a slower rate. As a result the cost per ton dropped from £1:13:10 for the lowest yielding group to £1:7:7 per ton for the highest yielding group.

4. Within each of the three groups studied, yields per acre tended to vary directly with manure costs.

5. Use of the precision seeder brought about a saving in singling time of 5.7 labour hours, worth £1:5:8 per acre. Of the seven crops precision sown and eaten off by sheep, three that were sown at six inch spacing and unthinned had a saving in time for secondary cultivations over the four crops that were thinned, of 21.6 labour hours and 3.1 tractor hours per acre. The total saving in cost was £5:10:5 per acre.

6. Fourteen crops were topped and tailed by machine and the saving in labour time was 13.3 hours but tractor hours showed a slight increase of 1.7 hours per acre. The total saving in cost amounted to £2:8:7 per acre.

7. The total labour time per acre for the harvested crops receiving dung and compound manures was 78.9 hours and for those receiving compound manures only was 82.8 hours. The total tractor times per acre were 34.4 hours and 25.0 hours respectively. Total labour and tractor times for the unharvested crops eaten off by sheep (each receiving compound manures and one, in addition, a dressing of dung), amounted to 24.9 hours and 11.0 hours respectively.
Manual Labour

All labour including the farmer’s own was charged at the hourly rates on the farm.

Tractor Work

Charged at 4s. 6d. per hour for wheeled tractors and 12s. per hour for track-laying tractors.

Manures and Manurial Residues

a) Dung was charged at 17s. per ton plus the cost of application.

b) Artificial manure was charged at cost plus cost of application.

c) Manurial residues brought forward and carried forward were calculated at standard rates.

Other Crop Costs

These include the cost of spray material.

Rent

Charged at the rental for arable land on the farm.

Overheads

Charges at the rates agreed by the Scottish Conference of Agricultural Economists. Charges for interest on tenants’ capital or for manaterial work have not been included.