

# GRASS UTILIZATION DURING FOREST ESTABLISHMENT

B. A. BROOK\*

## SYNOPSIS

*This paper is a summary of an investigation into alternative systems of grass harvesting and their comparative economics during the establishment of trees on an area where contour permits the use of farm machinery. The establishment period is taken as three years from planting, assuming that after this period the area may be grazed by cattle without fear of damage to the trees. The systems of utilization considered were the making of hay or silage, and the cutting and carting of fresh grass.*

*After allowing for such factors as the area covered by the trees, the loss of fertility, efficiency of utilization of the grass grown, costs of harvesting and feeding out, the value of the grass grown was assessed in each of the three years. The profit margin was then assessed on a per hectare basis, and findings due to the systems of utilization envisaged were: Year one, profit of \$24.30/ha; year two, break even; year three, loss of \$17.30/ha.*

## INTRODUCTION

A client, Mr Grazier, was given the opportunity to utilize the grass from an area to be planted in pine trees. The district is one in which sheep are rarely grazed, and Mr Grazier is a dairy farmer whose property lies on the Rangitaiki Plains in the eastern Bay of Plenty. The area to be planted is situated at Matahina on very light pumice country. There was no intention of combining grazing with forest production throughout the rotation. Mr Grazier also has access to an area which was planted four years previously. He winters his dairy herd on this area which is only 5 km from the area to be planted. Mr Grazier envisaged storing the grass grown on the newly planted area as winter feed and feeding it to the dairy herd whilst grazing the nearby four-year-old plantation.

The owners of the planted areas, Messrs F. O. R. Owner, requested that Mr Grazier make an offer on a per hectare basis for the use of the area to be newly planted. The offer was then to be arrived at by considering the value of the grass utilized together with the cost of handling (i.e., harvesting and feeding out). The unit for determining the grass yield is a kilogram of dry matter.

---

\*Farm Management Consultant, Whakatane.

### PRODUCTION OF DRY MATTER

The total dry matter production from the area, if under grass, would be as follows:

|            |      |      |      |                            |
|------------|------|------|------|----------------------------|
| Year one   | .... | .... | .... | 6700 kg/ha                 |
| Year two   | .... | .... | .... | 6100 kg/ha (10% reduction) |
| Year three | .... | .... | .... | 5000 kg/ha (25% reduction) |

It would not be possible to harvest this theoretical maximum for various reasons. Allowance must be made for efficiency of utilization on the area occupied by trees, which are to be planted in lines 4.4 m apart. It is estimated that the width of crowns will be 0.6 m in the first year, 1.1 m in the second, and 1.8 m in the third year. Allowing for a 5 m headland, the area per hectare not available for harvesting grass will thus be 460 m<sup>2</sup> in the first year (11.2% reduction), 800 m<sup>2</sup> in the second (19.6%) and 1370 m<sup>2</sup> in the third year (33.6%). In addition, not all the grass grown can be utilized. If the area were grazed, the percentage utilization would be 10% to 20% higher than if the grass were harvested by machine. A level of utilization of 70% has been assumed. Thus, after allowing for these two factors, the total dry matter harvested will be:

|            |      |      |      |      |      |            |
|------------|------|------|------|------|------|------------|
| Year one   | .... | .... | .... | .... | .... | 4200 kg/ha |
| Year two   | .... | .... | .... | .... | .... | 3050 kg/ha |
| Year three | .... | .... | .... | .... | .... | 2350 kg/ha |

### SYSTEMS OF UTILIZATION OF GRASS

The three forms of harvest considered were the making of hay, the making of silage, and the harvesting of fresh grass for immediate feeding. The weather would be the major factor determining the form of harvest, so the pattern of utilization decided upon was:

| <i>Month</i> | <i>Percentage of Total<br/>Grass Harvested</i> | <i>Form of Harvest</i> |
|--------------|--|------------------------|
| September    | 35   | Silage                 |
| December     | 40   | Hay                    |
| June         | 25   | Fresh grass            |

#### *Production of Silage*

With 35% of each year's total grass harvested in the form of silage, the dry matter yield is 1463 kg/ha in the first year, 1194 in the second, and 824 in the third year. The associated costs are calculated as follows.

#### *1. Harvesting*

Owing to the inconvenience of the trees and the extra cartage involved, the rate of harvest used is 0.4 ha/hour. The current rate for forage harvesting is \$6.50/hour. Whilst the

crop is being harvested, two men are required on the stack, and one tractor is used for consolidating the stack. It is assumed that this is done concurrently with harvesting. The only additional cost is for labour for covering the stack with polythene. In the first year the costs would be:

|                                | \$/hectare   |
|--------------------------------|--------------|
| Silicator and operator ....    | 16.10        |
| Man on stack ....              | 3.20         |
| Tractor for consolidating .... | 6.20         |
| Tractor operator ....          | 3.20         |
| Covering stack ....            | 1.20         |
| Total cost                     | <u>29.90</u> |

With a yield of 1463 kg/ha of dry matter as silage, the harvesting cost in the first year would be 2.04 cents/kg of dry matter.

In the second year, the rate of harvesting should increase since there is less grass to harvest per hectare. The width of cut in the first year would be 3.8 m, requiring three runs with the machine. In the second year the width would be reduced to 3.4 m, but this would still require three runs, and the rate of harvesting would remain at 0.4 ha/hour. There would be some saving on the stack, as one man could handle the grass coming in. The cost is estimated at \$26.70/ha or 2.22 cents/kg of dry matter.

In the third year, the width of cut would be reduced to 2.6 m, and the number of runs with the machine between rows of trees would be reduced to two. The cost of harvesting would be reduced to \$20.70/ha while the cost per kg of dry matter would be 2.51 cents.

## 2. Feeding Out

Feeding out consists of loading, travelling and unloading. Machinery consists of one tractor and one flat trailer measuring 3.0 m × 2.4 m. This would carry 3.4 m<sup>3</sup> which, at 720 kg/m<sup>3</sup>, would total some 2.4 tonnes. Two men would be required, and would take some 35 minutes to load the trailer. The distance from the harvesting to the feeding out area is some 5 km (10 km the round trip) which, at an average speed of 24 km/hr, would take 24 min. For unloading, one man drives the tractor and the second man feeds out from the trailer; time taken could be 30 min. The total cost in man-hours would thus be 2.96 per load, and in tractor and trailer hours 1.48. Costs are:

|   |               |
|---|---------------|
| Labour: 2.96 man-hours @ \$1.30 per hour .... | \$3.85        |
| Machine hire @ \$2.50 per hour ....           | <u>\$3.70</u> |
| Total cost per load                           | <u>\$7.55</u> |

Each load is 2450 kg of silage which, at 20% dry matter, equates with 490 kg dry matter. The total cost of feeding out per kg of dry matter is thus 1.54 cents.

### 3. Total Cost of Silage

| Year | Yield<br>(kg/ha) | Cost/kg DM<br>(cents) | Cost/ha<br>(\$) |
|------|------------------|-----------------------|-----------------|
| 1    | 1463             | 3.58                  | 52.50           |
| 2    | 1194             | 3.76                  | 45.00           |
| 3    | 824              | 4.05                  | 33.40           |

### Production of Hay

Assuming 40% of production is harvested in the form of hay, the production of dry matter in the first year would be 1670 kg/ha. In the second year it would be 1362 kg/ha, and in the third 939 kg/ha.

#### 1. Harvesting

Local contract rates are 11 cents each for cutting and drying, baling, and carting to barn—a total of 33 cents per bale in barn. One bale of hay contains 21.8 kg of dry matter. Harvesting cost per kg of dry matter is therefore 1.51 cents/kg.

#### 2. Feeding Out

Using the same trailer described above for silage, a load would be 90 bales, which two men could load in 20 min. The weight per load would be slightly less than for silage—2286 kg. Travelling time would be slightly more—say, 30 min the round trip. Feeding out time would be the same—30 min. Total costs would be:

|                                   |      |      |      |               |
|-----------------------------------|------|------|------|---------------|
| Labour: 2.66 man-hours @ \$1.30   | .... | .... | .... | \$3.46        |
| Machine hire: 1.33 hours @ \$2.50 | .... | .... | .... | \$3.33        |
| Total cost per load               |      |      |      | <u>\$6.79</u> |

One load contains 1960 kg of dry matter, so the total cost of feeding out is 0.35 cents/kg. This is much lower than the cost of silage, which contains only 20% dry matter, 80% being water. Hay contains only 15% water.

### 3. Total Cost of Hay

| Year | Yield<br>(kg/ha) | Cost/kg DM<br>(cents) | Cost/ha<br>(\$) |
|------|------------------|-----------------------|-----------------|
| 1    | 1670             | 1.86                  | 31.00           |
| 2    | 1362             | 1.86                  | 25.55           |
| 3    | 939              | 1.86                  | 17.45           |

*Production of Fresh Grass*

Of the total harvest, 25% is in the form of fresh grass. Dry matter production would be 1045 kg/ha in the first year, 852 kg/ha in the second and 585 kg/ha in the third year.

*1. Harvesting*

The operation envisaged is to silorate the material into a basket on a trailer and to cart the cut grass to the stock in the basket. Thus, harvesting will be similar to the silage operation. With only about 50 bales of hay equivalent per ha in the first year the rate of silorating should be 0.51 ha/hour. In the second year this would increase to 0.54 ha/hour, and to 0.61 ha/hour in the third year. One operator, with a tractor, forage harvester and trailer would be required. Times taken to harvest one load would be 0.17 hours in the first year, 0.20 in the second and 0.25 in the third (10, 12 and 15 min, respectively). A load would be about half a tonne (454 kg wet material) containing some 91 kg dry matter. At an all-in cost of \$6.50 per hour, the cost per kg would be 1.21 cents in the first year, 1.43 in the second and 1.79 in the third.

*2. Feeding Out*

Once the trailer is full, the operator will travel to the stock, a distance of about 5km, and will dump the load. He would spend about ten minutes per load in spreading the heap over the ground for ease of stock access. Cartage would be at about 29 km/hr — thus about 0.33 hours per load. Costs are:

|                                   |       |               |
|-----------------------------------|-------|---------------|
| Labour: 0.50 hours @ \$1.30       | ..... | \$0.65        |
| Machine hire: 0.33 hours @ \$3.00 | ..... | \$1.00        |
| Total cost per load               |       | <u>\$1.65</u> |

Total feeding out cost will thus be 1.82 cents per kg dry matter.

*3. Total Cost of Fresh Grass*

| Year | Yield<br>(kg/ha) | Cost/kg DM<br>(cents) | Cost/ha<br>(\$) |
|------|------------------|-----------------------|-----------------|
| 1    | 1045             | 3.03                  | 31.70           |
| 2    | 852              | 3.25                  | 27.70           |
| 3    | 585              | 3.61                  | 21.10           |

## VALUE OF PRODUCTION OVER THREE YEARS

### *Value of Dry Matter Production*

In comparing hay, silage or fresh grass it is necessary to take account of the feed value, or feed quality per kg of dry matter. It is envisaged that, with a sward containing plantain, Yorkshire fog, bromus mollis, some white clover and ryegrass, and an abundance of *Poa* spp., together with some ragwort, the quality is only average and will deteriorate throughout the three year term. Using feed quality in the first year as a base of 100, the order of deterioration would mean the feed quality ranking in year two would be 85 and only 70 in the third year, largely as a result of spread of ragwort and lack of fertilizer applications. In addition, the ranking of different forms of feed would be as follows:

1 kg of dry matter in cut grass = 1.5 kg dry matter in hay

1 kg of dry matter in silage = 1.25 kg dry matter in hay

To determine the monetary value of the dry matter produced the fair market price of a bale of hay, which is taken as 60 cents, will be used, bearing in mind deterioration in feed value with time and also the increase in ragwort. A bale of hay containing 21.8 kg of dry matter means that 1 kg of dry matter in hay is worth 2.75 cents, in the first year. Allowing for differences in feed quality with type of produce and with time, the value per kg of dry matter harvested is:

| Year | Value in cents per kg DM |        |      |
|------|--------------------------|--------|------|
|      | Cut grass                | Silage | Hay  |
| 1    | 4.13                     | 3.44   | 2.75 |
| 2    | 3.50                     | 2.92   | 2.34 |
| 3    | 2.88                     | 2.40   | 1.92 |

### *Profit and Loss*

After determining the costs per kg of dry matter in each year for each type of feed, and the corresponding value per kg, it is possible to arrive at a profit margin on the basis of one kg of dry matter, as follows:

|             | Year  |       |       |
|-------------|-------|-------|-------|
|             | 1     | 2     | 3     |
| Cut grass:  |       |       |       |
| Value*      | 4.13  | 3.50  | 2.88  |
| Costs       | 3.03  | 3.25  | 3.61  |
| Profit/Loss | +1.10 | +0.25 | -0.73 |
| Silage:     |       |       |       |
| Value       | 3.44  | 2.92  | 2.40  |
| Costs       | 3.58  | 3.76  | 4.05  |
| Profit/Loss | -0.14 | -0.84 | -1.65 |
| Hay:        |       |       |       |
| Value       | 2.75  | 2.34  | 1.92  |
| Costs       | 1.86  | 1.86  | 1.86  |
| Profit/Loss | +0.89 | +0.48 | +0.06 |

\*All figures in cents per kg of dry matter.

It is clear that silage as a means of utilization is not profitable in any year, and that hay making is the most profitable system overall. Using our earlier assumption on the pattern of utilization of 40% hay, 35% silage and 25% cut grass, the profit margin per hectare would be as follows:

*Profit Loss Net*

Year one — 4178 kg/ha dry matter harvested:

|                                       |      |      |      |         |                  |
|---------------------------------------|------|------|------|---------|------------------|
| 1045 kg/ha in cut grass @ +1.10 cents | .... | .... | .... | \$11.50 |                  |
| 1463 kg/ha in silage @ -0.14          | .... | .... | .... |         | \$2.05           |
| 1670 kg/ha in hay @ +0.89             | .... | .... | .... | \$14.86 |                  |
| Total per hectare                     |      |      |      |         | <u>+ \$24.31</u> |

Year two — 3408 kg/ha dry matter harvested:

|                                |      |      |      |        |                 |
|--------------------------------|------|------|------|--------|-----------------|
| 852 kg/ha in cut grass @ +0.25 | .... | .... | .... | \$2.13 |                 |
| 1194 kg/ha in silage @ -0.84   | .... | .... | .... |        | \$10.03         |
| 1362 kg/ha in hay @ +0.48      | .... | .... | .... | \$6.54 |                 |
| Total per hectare              |      |      |      |        | <u>- \$1.36</u> |

Year three — 2348 kg/ha dry matter harvested:

|                                |      |      |      |        |                 |
|--------------------------------|------|------|------|--------|-----------------|
| 585 kg/ha in cut grass @ -0.73 | .... | .... | .... | \$4.27 |                 |
| 824 kg/ha in silage @ -1.65    | .... | .... | .... |        | \$13.59         |
| 939 kg/ha in hay @ +0.06       | .... | .... | .... | \$0.55 |                 |
| Total per hectare              |      |      |      |        | <u>-\$17.31</u> |

After three years, therefore, the accumulated profits and losses amount to a profit margin of \$5.64/hectare.

*Annual Payments*

Having arrived at the overall profit margin, Mr Grazier is now in a position to determine his offer to Messrs F. O. R. Owner on a per hectare basis. He is also able to discuss the systems of utilization as this obviously would affect the profitability of the programme. Using the pattern of utilization determined at the outset, together with the overall profit margin of \$5.64/ha, the offer was arrived at by sharing the profit on a 50/50 basis with Messrs F. O. R. Owner over the three year term — i.e.,  $5.64/2 \times 1/3 = 0.94$  cents/ha/year.

The investigation illustrates the narrow profit margin to be expected when harvesting grass solely with machinery, as well as outlining the variability of the profit margin depending on the system of utilization.