"Some Economic Aspects of Feed Lot Fattening"

by

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INTRODUCTION

Data obtained at several centres in Queensland have been used in considering the effects of animal size, quality of ration and inheritance on the performance of animals in the feed lot. The data are discussed in relation to accepted feeding standards as stated by the National Research Council (1950).

THE INFLUENCE OF ANIMAL SIZE ON FEED UTILISATION

By making the assumption that animals of different ages have been on comparable planes of nutrition the terms “younger” and “lighter” are synonymous. The terms “older” and “heavier” are used in a similar way.

In considering efficiency of food utilisation the economy of the lighter animal should be recognised. This is demonstrated by partitioning the total ration into its maintenance and production portions.

To the fatter, the maintenance requirements of animals represents a non-productive fraction of the ration. This fraction varies according to the size of the animal. In “Recommended Nutrient Allowances for Beef Cattle” the National Research Council (1950) standards indicate that the maintenance requirements of beef animals vary in proportion to the 0.75 power of live bodyweight. The requirement per 1,000 lb. animal is 8 lb. of T.D.N. (This applies to stalled animals — maintenance requirements of grazing animals are considerably higher). The following table of maintenance requirements is obtained by the use of formula — (Franklin — 1953) :-

\[
8 \times \frac{0.75 \text{ power}}{1,000} \text{Liveweight} \]

<table>
<thead>
<tr>
<th>Live Weight (lb.)</th>
<th>T.D.N. Requirement for Maintenance (lb. per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>4.1</td>
</tr>
<tr>
<td>500</td>
<td>4.7</td>
</tr>
<tr>
<td>600</td>
<td>5.4</td>
</tr>
<tr>
<td>700</td>
<td>6.1</td>
</tr>
<tr>
<td>800</td>
<td>6.7</td>
</tr>
<tr>
<td>900</td>
<td>7.4</td>
</tr>
<tr>
<td>1000</td>
<td>8.0</td>
</tr>
<tr>
<td>1100</td>
<td>8.6</td>
</tr>
<tr>
<td>1200</td>
<td>9.2</td>
</tr>
</tbody>
</table>

* Department of Agriculture and Stock, Queensland.
The significance of the influence of maintenance requirements on the proportion of the ration available for production can be viewed from two aspects. Firstly, the utilisation of a fixed quantity of feed is considered. Table II shows the percentage of a fixed quantity of feed which is available for productive purposes when utilised by animals of different bodyweights. The foodstuff under consideration has a dry matter content of 90 per cent. and a T.D.N. content of 70 per cent. The maintenance requirements of each class of animal are given after each has been on feed for 40-50 days and is in a similar stage of fatness.

### TABLE II.

**Utilisation of a Fixed Quantity of Feed by Animals of Different Weights**

<table>
<thead>
<tr>
<th>Liveweight (lb.)</th>
<th>FEED INTAKE</th>
<th>Maintenance Requirement</th>
<th>Available for Production</th>
<th>Percentage of Ration Available for Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>14 9.8</td>
<td>4.7</td>
<td>5.1</td>
<td>52%</td>
</tr>
<tr>
<td>700</td>
<td>14 9.8</td>
<td>6.1</td>
<td>3.7</td>
<td>98%</td>
</tr>
<tr>
<td>900</td>
<td>14 9.8</td>
<td>7.4</td>
<td>2.4</td>
<td>24%</td>
</tr>
</tbody>
</table>

A second aspect of the influence of animal size on efficiency of conversion of fodder to meat appears in Table III which shows the quantity of feed required per pound of liveweight gain for animals of different weights. This table is derived from Tables I and II of National Research Council 1950, No. IV.

### TABLE III.

**Feed Requirements per Pound of Liveweight Gain**

<table>
<thead>
<tr>
<th>Liveweight (lb.)</th>
<th>Daily Feed (lb.) 90% Drymatter</th>
<th>Required T.D.N. Content of Feed Per Cent.</th>
<th>Expected Gain (lb./Day)</th>
<th>REQUIREMENT PER POUND LIVEWIGHT GAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T.D.N.</td>
<td></td>
<td></td>
<td>lb. Feed</td>
</tr>
<tr>
<td></td>
<td>90%</td>
<td>Expected Gain (lb./Day)</td>
<td></td>
<td>lb. T.D.N.</td>
</tr>
<tr>
<td>500</td>
<td>14</td>
<td>68</td>
<td>2.0</td>
<td>7.0</td>
</tr>
<tr>
<td>700</td>
<td>21</td>
<td>65</td>
<td>2.2</td>
<td>9.5</td>
</tr>
<tr>
<td>900</td>
<td>26</td>
<td>62</td>
<td>2.4</td>
<td>10.8</td>
</tr>
</tbody>
</table>

Data recorded in lot fattening projects on the Darling Downs during 1959 support the calculated efficiencies of gain. Table IV compares the performance of 78 head of yearlings with a group of 49 calves. Both groups were fed a ration comprising 2 parts of grain sorghum or barley to 1 part of lucerne hay by weight having an estimated digestible protein content of 8.7 per cent. and an estimated total digestible nutrient content of 70 per cent. The fodder was milled prior to feeding.
TABLE IV.
Comparative Performance of Yearlings and Calves

<table>
<thead>
<tr>
<th>Average of Groups</th>
<th>Yearlings</th>
<th>Calves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Weight (lb.)</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>Final Weight (lb.)</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>No. of Days</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>Total Gain (lb.)</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>Average Gain Per Day (lb.)</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>Total Feed Consumption Per Animal (lb.)</td>
<td>1911</td>
<td>1362</td>
</tr>
<tr>
<td>Average Feed Consumption/Animal/Day</td>
<td>19.5</td>
<td>12.05</td>
</tr>
<tr>
<td>Average Feed Consumption Per lb. Live-weight Gain (lb.)</td>
<td>7.90</td>
<td>6.09</td>
</tr>
<tr>
<td>Est. T.D.N. Consumption/Animal/Day (lb.)</td>
<td>.....</td>
<td>.....</td>
</tr>
<tr>
<td>Est. T.D.N. Consumption Per lb. Live-weight Gain (lb.)</td>
<td>.....</td>
<td>.....</td>
</tr>
</tbody>
</table>

There is good agreement between these figures in terms of requirement per pound liveweight gain and those published by the National Research Council (1950). Refer to Table III.

It is evident that the lightweight animal (400-500 lb.) is more efficient in the conversion of a given quantity of a suitable ration to meat production. However, the larger animal will probably make greater total gains as it makes a compensatory gain following a period of retarded growth. Data from Snapp (1952) quotes 2 year old steers which were fully fed from birth gaining at the rate of 0.92 lb. daily from 612 to 943 days of age. This is contrasted with 2 year old steers fattened in 150 days after being grown under commercial conditions. The average rate of gain for the fattening period was 2.60 lb. daily under these circumstances.

UTILISATION OF BY-PRODUCT ROUGHAGES

By-product roughages are available in limited quantities from canneries and from organisations engaged in the extraction of oils from seeds.

In order to compare the estimated foodstuff values of some of these by-products with fair quality lucerne hay and grain sorghum the following table has been compiled. The comparisons are shown for Dry Matter, Digestible Protein and Total Digestible Nutrients. Pineapple waste from canneries has been taken as unity in each case.

TABLE V.
Comparative Foodstuff Value of Some Common By-Products

<table>
<thead>
<tr>
<th>Foodstuff</th>
<th>Drymatter</th>
<th>Digestible Protein</th>
<th>Total Digestible Nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pineapple Cannery Waste</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Molasses</td>
<td>5.0</td>
<td>—</td>
<td>6.0</td>
</tr>
<tr>
<td>Peanut Hulls</td>
<td>6.0</td>
<td>39.0</td>
<td>2.6</td>
</tr>
<tr>
<td>Cottonseed Hulls</td>
<td>6.0</td>
<td>—</td>
<td>4.4</td>
</tr>
<tr>
<td>Sugar Cane (Immature)</td>
<td>1.6</td>
<td>11.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Wet Brewer's Grains</td>
<td>1.6</td>
<td>45.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Lucerne Hay</td>
<td>6.0</td>
<td>112.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>6.0</td>
<td>90.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>
The data in Table V are based on average composition and digestible nutrients of the materials from data by Morrison (1956), Schneider (1947) and analyses by Agricultural Chemist and Biochemist of Department of Agriculture and Stock. In the case of growing plant material such as sugar cane the foodstuff value varies with the stage of growth.

It has been pointed out previously (see Table III) that older animals can be fattened satisfactorily on a ration which is lower in quality than that needed for younger and lighter animals. Since the differences in efficiency between the two types of animals lie mainly in the quantity of feed required for maintenance it is useful to compare the animals on this basis.

**TABLE VI.**

**Maintenance Requirements of Different Animals**

<table>
<thead>
<tr>
<th>Weight of Animal (lb.)</th>
<th>Lb. of Feed (90% D.M.)</th>
<th>AVERAGE COMPOSITION OF FEED (90% D.M Basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>D.P. %</td>
</tr>
<tr>
<td>500</td>
<td>6.9</td>
<td>8.6</td>
</tr>
<tr>
<td>900</td>
<td>11.9</td>
<td>6.3</td>
</tr>
</tbody>
</table>

From Table VI it is evident that the heavier animal requires an additional 5 lb. of feed for maintenance. However, in order to raise the lower quality ration to an acceptable standard for the younger animal it is necessary to replace 40 per cent. of the low quality ration with a mixture composed of grain 6 parts and a protein rich meal (such as cottonseed) 1 part.

The appetite requirements of the younger and older animals are 14 lb. and 26 lb. respectively. (See Table III.)

**TABLE VII.**

**Use of Low Quality Roughage by Different Classes of Animals**

<table>
<thead>
<tr>
<th>90% Drymatter Basis</th>
<th>YOUNG ANIMALS (500 lb.)</th>
<th>OLDER ANIMALS (900 lb.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maintenance (lb.)</td>
<td>Production (av. 21 lb. / day)</td>
</tr>
<tr>
<td>Low Quality Roughage (lb.)</td>
<td>4.14</td>
<td>4.26</td>
</tr>
<tr>
<td>Concentrate Mixture (lb.)</td>
<td>2.76</td>
<td>2.84</td>
</tr>
</tbody>
</table>

**Totals:**

- Roughage (lb.) 8.4 26.0
- Concentrates (lb.) 5.6

**lb. Feed Per 1 lb. Live Wt. Increase:**

- Roughage (lb.) 4.2 10.8
- Concentrates (lb.) 2.8

Other things being equal the alternatives in the case stated in Table VII lie between the cost of feeding 6.6 lb. of low quality roughage (90% dry matter basis) and 2.8 lb. of concentrates per pound liveweight increase.
From the nutritional viewpoint it is indicated that feed costs are approximately equal for these two classes of animal when the cost of the low quality ration per pound of 90% dry matter material is somewhat less than half that of the prescribed grain-meal mixture.

However, it is clear that ration quality need not be a limiting factor when grain is the major component.

PURCHASE PRICE OF ANIMALS

In practice, the value per 100 lb. of the store animal in relation to the value per 100 lb. of the fat animal will play a large part in determining which type of cattle are used. Consideration of this aspect is outside the scope of this paper, as is the important consideration of market suitability of the carcass.

STAGE OF FATNESS

As the state of fatness proceeds, progressively more feed is required per pound of liveweight gain. More feed is required for the production of one pound of fat compared with one pound of muscle. As animals become fat the proportion of stored fat to muscle increases. It is thus essential that animals be turned off as soon as they reach a fit condition for slaughter.

The English feeding standards given by Woodman (1948) for 9 cwt. steers during the fattening period are shown in terms of requirements per pound liveweight gain above maintenance. The average live weight increase is taken at approximately 2 lb./day.

**TABLE VIII.**

<table>
<thead>
<tr>
<th>Energy Requirement per Pound of Liveweight Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate Age and Condition of Bullock</td>
</tr>
<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Ordinary Store Condition</td>
</tr>
<tr>
<td>Forward Store Condition</td>
</tr>
<tr>
<td>Half-fat Condition</td>
</tr>
<tr>
<td>Fat Condition</td>
</tr>
</tbody>
</table>

LEVEL OF FEEDING

A high daily rate of gain increases the production to maintenance ratio of the ration. This reduces the cost of maintenance relative to a given production and under normal fattening conditions feeding for rates of gain close to the maximum will be the most economical method.

DIGESTIBILITY OF RATION

While the average performance of animals under observation in local trials has approximated to the standard set by American authorities there are grounds for believing that maximum efficiency of utilisation has not been reached in early projects. In digestibility studies Harvey (1952) found that locally grown grain sorghum had a higher nutritive value than that recorded by overseas workers. On that basis it would be reasonable to expect above average gains from rations composed principally of grain sorghum.

In an early project during 1959 the lucerne hay component was finely milled and fed with the grain. A later project has shown better rates of gain after a change in which half the daily ration of lucerne was fed as hay.
FEED COST AND CARCASS GAIN

Table IX shows feed cost per 100 lb. estimated carcass gain and is based on the performance of 78 head of yearlings in three different groups. The costs are related to a mixture consisting of 2 parts milled grain to one part of milled lucerne hay. The animals concerned made an average gain of 2.47 lb. daily from an average intake over 98 days of 13.0 lb. grain and 6.5 lb. hay.

TABLE IX
Feed Cost in Shillings to Produce 100 lb. Carcass Beef at Varying Feed Prices

<table>
<thead>
<tr>
<th>Grain Cost Per Ton</th>
<th>£5</th>
<th>£10</th>
<th>£15</th>
<th>£20</th>
</tr>
</thead>
<tbody>
<tr>
<td>£5</td>
<td>58/-</td>
<td>77/-</td>
<td>96/-</td>
<td>115/-</td>
</tr>
<tr>
<td>£10</td>
<td>60/-</td>
<td>85/-</td>
<td>110/-</td>
<td>135/-</td>
</tr>
<tr>
<td>£15</td>
<td>70/-</td>
<td>100/-</td>
<td>135/-</td>
<td>160/-</td>
</tr>
<tr>
<td>£20</td>
<td>80/-</td>
<td>115/-</td>
<td>150/-</td>
<td>175/-</td>
</tr>
</tbody>
</table>

Costs for intermediate prices of hay and grain are obtainable as follows. In the case of hay the cost per 100 lb. carcass should be increased by approximately 4/- for every £1 a ton increase in hay price. For every £1 a ton increase in grain price the cost per 100 lb. carcass is increased by nearly 8/-.

INDIVIDUAL VARIATION BETWEEN ANIMALS

Considerable variation is evident between the performance of individual animals in a feed lot. With reference to the 78 head of yearlings for which input-output data are presented the following ranges of weight gain have emerged.

TABLE X
Range of Response of Weight Gain in Feed Lots

<table>
<thead>
<tr>
<th>No. of Animals</th>
<th>Range (lb. Per Day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1.50 to 1.90 lb.</td>
</tr>
<tr>
<td>26</td>
<td>2.00 to 2.40</td>
</tr>
<tr>
<td>26</td>
<td>2.50 to 2.90</td>
</tr>
<tr>
<td>17</td>
<td>3.00 to 3.40</td>
</tr>
<tr>
<td>3</td>
<td>3.50 to 4.00</td>
</tr>
</tbody>
</table>

The mean daily rate of gain for 78 head was 2.47 lb.

Since animals were fed in group lots individual intake was not recorded. Variation in feed intake may account for part of the differences in weight gain but it is considered that all animals were able to eat to appetite. Trough space of 18 in. for calves and 2 feet for yearlings was adequate to allow all animals to eat at one time. Animals were fed twice daily with the ration adjusted continually to ensure that the quantity of feed supplied at one feeding was just consumed by the time of subsequent feeding. In the opinion of the authors, all animals had adequate access to the feed provided and the observed variations in performance indicate differences between animals in the efficiency of conversion of foodstuff to meat. This characteristic is fairly strongly inherited. Heritability estimates for
beef cattle quoted by Warwick (1958) show an average estimate of 45 per cent. for post-weaning feedlot gain and 39 per cent. for efficiency of feedlot gain. Estimates of this order indicate that worthwhile progress could be made by using stock by sires which have been performance recorded and proved to be superior in feedlot performance. This is a development which should accompany expansion of feedlot fattening in order to ensure a supply of efficient animals for the purpose.

REFERENCES


National Research Council (1950) Number IV.—“Recommended Nutrient Allowances for Beef Cattle.”


