

## Economic Benefits of Improving Feed Efficiency by Increasing Average Daily Gain or Decreasing Dry Matter Intake of Fed Cattle

### Introduction

The beef industry has been very conscious of feed efficiency during the finishing phase compared with competitive protein sources for human consumption such as pork and poultry. This emphasis has resulted in several generalizations that may or may not be true depending on current economic conditions. Feed efficiency is perceived, by many, to be the most important performance parameter affecting the economics of cattle feeding regardless of ration cost or the price of fed cattle. As a consequence of this belief, improving feed efficiency by allowing average daily gain to decrease an equal percentage has been viewed as having economic benefit at all times. Comparisons of the economic benefits from improvements in average daily gain or feed efficiency are difficult for many to separate. This occurs because feed efficiency is the ratio between daily dry matter intake and average daily gain. Hence, some have suggested that any improvements in average daily gain have been accounted for by the feed efficiency ratio.

Feed efficiency can be improved by one of four events. Dry matter intake can decrease without any change in rate of gain. Average daily gain can increase without any change in daily dry matter intake. Average daily gain can increase to a greater extent than the accompanying rise in dry matter intake. Average daily gain and dry matter intake can be decreased with the decrease in dry matter intake being greater than that noted with average daily gain. The four possible methods of improving feed efficiency result in economic benefits that are not equal. The objective of this Technical Bulletin is to explore the economic benefits obtained from improvements in feed efficiency obtained by increasing average daily gain while maintaining daily dry matter intake or by decreasing dry matter intake while maintaining average daily gain across a wide range of ration costs, fed cattle prices and final cattle weights.

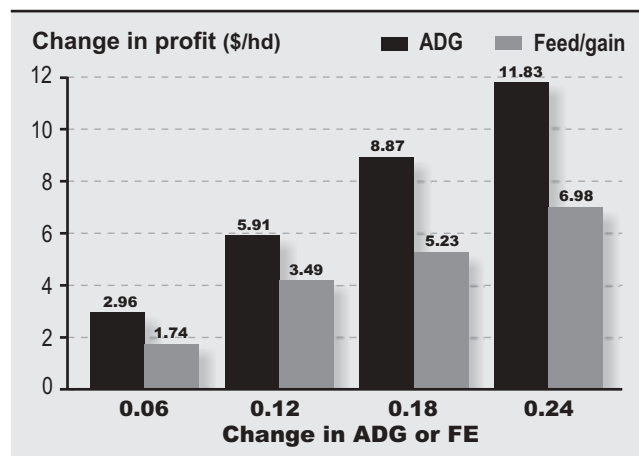
### Description of Economic Model and Parameters

The relationship between average daily gain, feed efficiency, and daily dry matter intake is fundamental to understanding the economic model used for this analysis. Feed efficiency is calculated by dividing daily dry matter intake by average daily gain. Alternatively, feed efficiency can be calculated by dividing total feed consumed by a pen by the total weight gain for that pen. Regardless of the calculation method, if feed efficiency is decreased (improved) without any change in rate of gain, feed intake must decrease. If average daily gain or total gain is increased without any change in feed efficiency, dry matter intake must increase. Finally, if average daily gain increases without any accompanying increase in daily dry matter intake, feed efficiency must be decreased (improved).

The economic model used to assess the benefits of performance requires both average daily gain and feed efficiency values be inputted. The need for both average daily gain and feed efficiency in the model exists because the model must calculate daily dry matter intake or feed intake so that a cost can be assessed for the feed consumed. In reality, feed efficiency is only used in the models to make the calculation for daily dry matter intake. Feed efficiency serves no other purpose in the model. The model could be set to use daily dry matter intake rather than feed efficiency.

Expressing improvements in average daily gain and feed efficiency as percentages is problematic. Percentage changes ignore the fact that economic benefits result from absolute performance improvements. Therefore, the major problem with comparing changes in feed efficiency and average daily gain on a percentage basis is that a 1% improvement in feed efficiency is roughly twice as large as a 1% improvement in average daily gain. A more valid method of assessing the independent benefits of feed effi-

**FIGURE 1:** Impact of sequential 0.06 improvements in average daily gain or feed efficiency.



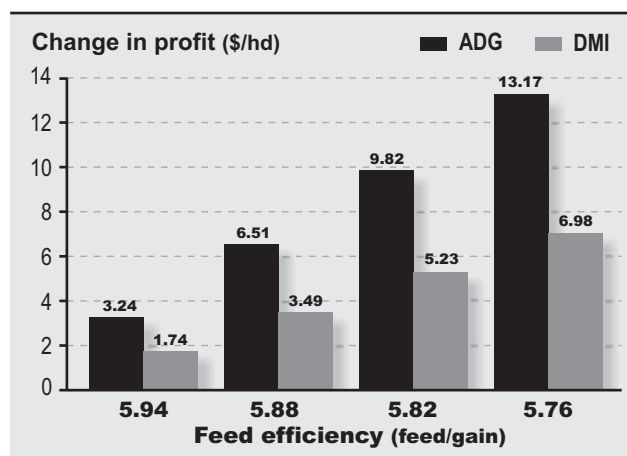
ciency and average daily gain would be to compare the same absolute magnitude improvement (i.e., a 0.06 improvement in average daily gain and feed efficiency).

To facilitate the comparison of equal performance improvements, average daily gain was fixed at 3.00 lb/d while feed efficiency was fixed at 6.00. Yearling steers with an initial weight of 750 lb were used in the analysis. The purchase price of 750 lb steers was \$77.05/cwt. Feeder cattle prices were based on a ten-year average of Cattle-Fax data from January 1988 to December of 1997. The final weight for this series of examples was fixed at 1200 lb. All cattle were assumed to be fed for an equal number of days; hence, cattle with a greater average daily gain would result in a saleable weight greater than 1200 lb. When the impact of feed costs were evaluated fed cattle prices were fixed at \$71.61/cwt based on the average Cattle-Fax fed cattle price from January 1988 until December 1997. Feed efficiency and ration costs were expressed on a 100% dry matter basis. For the purpose of this analysis, it was assumed that yardage, processing, medical, and any additional cost were not impacted by performance improvements.

### Benefits From Improving Animal Performance

Changes in profit/head when average daily gain was increased without changing feed efficiency and when feed efficiency was improved without changing average daily gain are shown in Figure 1. Each 0.06 enhancement of average daily gain resulted in a \$2.96 improvement in

**FIGURE 2:** Benefit of improving feed efficiency by increasing ADG or decreasing DMI.\*

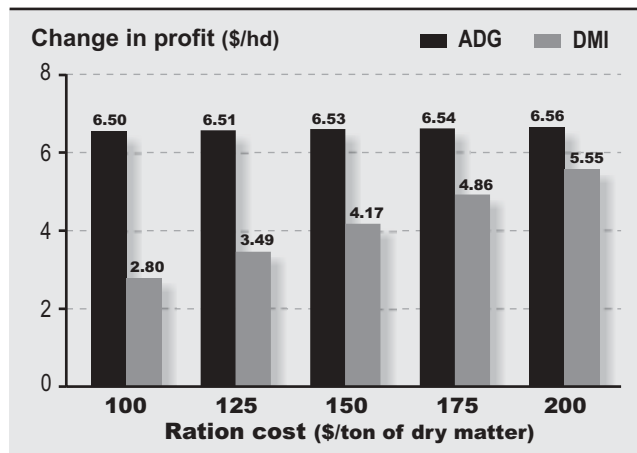


\* 0.06 improvement in feed efficiency obtained by increasing average daily gain while maintaining dry matter intake, or by decreasing dry matter intake while maintaining average daily gain; ration cost of \$125/ton of dry matter.

profit/head when ration costs were fixed at \$125/ton of DM. The improvement in profit (loss)/head is the result of a 9 lb incremental increase in weight gain through the 150-d feeding period. The improvements in profit from enhanced rate of gain are not free because feed intake increased by 0.36 lb for each incremental improvement in average daily gain. The cost of the feed (\$0.0625/lb of feed) was debited against the economic benefit of enhanced weight gain.

Each 0.06 improvement in feed efficiency resulted in a \$1.74 enhancement in profit /head. Enhanced profits from feed efficiency result from reduced feed intake with a constant average daily gain of 3.00 lb/d. When ration costs are \$154.50/ton and the fed cattle price is \$71.61/cwt a 0.06 improvement in average daily gain or feed efficiency is of equal benefit. If ration costs are less than \$154.50/ton, at this fed cattle price, improvements in average daily gain are of greater benefit than an equal improvement in feed efficiency obtained by reducing dry matter intake. The ration cost where equal improvements in rate of gain and feed efficiency obtained by decreasing dry matter intake are of the same benefit depends on the price of fed cattle. As the price of fed cattle increases, the ration cost where similar improvements in average daily gain and feed efficiency are of equal benefit, increases.

**FIGURE 3:** Effects of ration cost on the economic benefits of feed efficiency improvement obtained by increasing ADG or decreasing DMI.\*



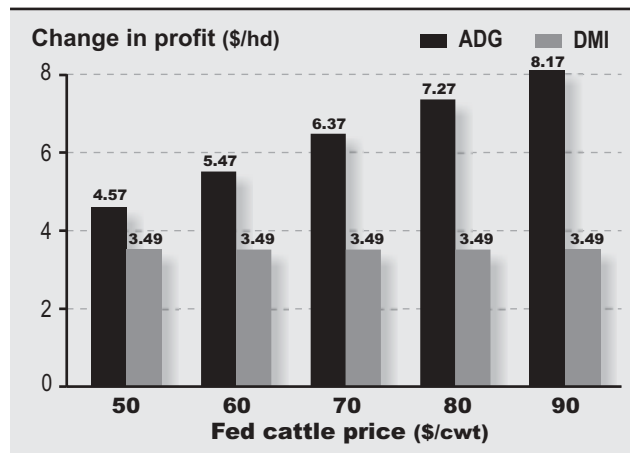
\* 0.12 improvement in feed efficiency obtained by increasing average daily gain while maintaining dry matter intake, or by decreasing dry matter intake while maintaining average daily gain; ration cost of \$125/ton of dry matter.

Of greater interest than the independent benefits of average daily gain and feed efficiency are the benefits obtained by improving feed efficiency by either decreasing daily dry matter intake while maintaining rate of gain or by maintaining dry matter intake while increasing average daily gain.

When ration costs were fixed at \$125/ton of dry matter, the benefits from improving feed efficiency by increasing average daily gain while maintaining a constant dry matter intake were nearly two times greater than those noted from maintaining rate of gain while decreasing dry matter intake (Figure 2). However, the benefits of the two improvements in feed efficiency are dependent on ration cost, fed cattle price and presumably days on feed or final weight.

To evaluate the benefits of the two improvements when ration cost increased from \$100 to \$200/ton of dry matter all other inputs were held constant. The fed cattle price was fixed at \$71.61/cwt., feeder price was fixed at \$77.05/cwt., cattle were fed for 150 days to a base final weight of 1200 lb and feed efficiency was improved by 0.12 units by increasing average daily gain or by decreasing dry matter intake.

**FIGURE 4:** Effects of fed cattle price on the economic benefits of feed efficiency improvement obtained by increasing ADG or decreasing DMI.\*



\* 0.12 improvement in feed efficiency obtained by increasing average daily gain while maintaining dry matter intake, or by decreasing dry matter intake while maintaining average daily gain; ration cost of \$125/ton of dry matter.

As ration costs increased from \$100 to \$200/ton of dry matter, the relative benefit noted from improving feed efficiency by decreasing dry matter intake ranged from \$2.80/hd to \$5.55/hd, respectively (Figure 3). The same change in ration cost resulted in an increase in the benefit from improved feed efficiency by increasing rate of gain ranged from \$6.50/hd to \$6.56/hd, respectively. This suggests that improving feed efficiency by decreasing dry matter intake is much more sensitive to changes in ration cost than feed efficiency improvements obtained by increasing average daily gain. When ration costs were \$237.50/ton of dry matter the benefits obtained from improving feed efficiency by increasing average daily gain or by decreasing dry matter intake were equal. However, ration cost where the benefits from improving feed efficiency by enhancing average daily gain or by decreasing dry matter intake are equal is dependent on the price of fed cattle.

Changing the price of fed cattle will have a greater impact on the benefits from increasing average daily gain than decreasing dry matter intake (Figure 4). As the price of fed cattle was increased in \$10/cwt increments from \$50 to \$90/cwt, the benefit from improving feed efficiency by increasing average daily gain increased from \$4.57 to \$8.17/hd, respectively. The net increase in profit/head as

fed cattle price was increased from \$50 to \$90/cwt was \$3.60/hd (\$8.17/hd - \$4.57/hd) when average daily gain was increased. Changing the price of fed cattle within a ration cost has no effect on the benefits from improving feed efficiency by decreasing dry matter intake while maintaining average daily gain. By maintaining average daily gain, final weight does not change and the reduction in feed consumption has a constant benefit of \$3.49/hd when ration cost was fixed at \$125/ton.

Table 1 depicts the benefits of improving feed efficiency by 0.12 from decreasing dry matter intake while maintaining average daily gain, and from increasing average daily gain while maintaining dry matter intake as influenced by fed cattle price and ration cost. As ration costs increase from \$100 to \$200/ton, the benefit of improved feed efficiency from decreasing dry matter intake (DMI-100, DMI-150, and DMI-200) increases from \$1.40 to \$5.55/hd, respectively. Within fed cattle price and across the same range of ration costs (\$100, \$150 and \$200/ton), improved feed efficiency from increasing average daily gain (ADG-100, ADG-150 and ADG-200) increased profit/hd by \$0.05/hd. Improvements in feed efficiency obtained from decreased dry matter intake are much more sensitive to increased ration cost than are improvements obtained from increased rate of gain. Conversely, improvements in feed

**TABLE 1.** Change in profit (\$/head) of improved feed efficiency obtained by increasing ADG or decreasing DMI at different ration costs and fed-cattle prices.\*

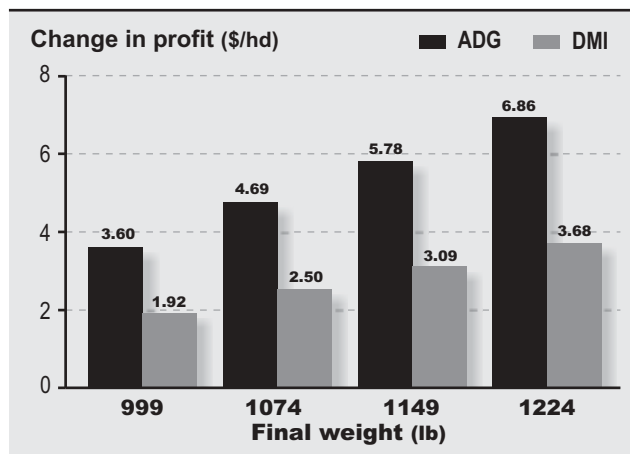
FE improve.- ration cost (\$)	Fed cattle price (\$/cwt)				
	50	60	70	80	90
DMI-100	2.80	2.80	2.80	2.80	2.80
DMI-150	4.17	4.17	4.17	4.17	4.17
DMI-200	5.55	5.55	5.55	5.55	5.55
ADG-100	4.56	5.46	6.36	7.26	8.16
ADG-150	4.58	5.48	6.38	7.28	8.18
ADG-200	4.61	5.51	6.41	7.31	8.21

\* 0.12 improvement in feed efficiency obtained by increasing average daily gain (ADG-100 to ADG-200) while maintaining dry matter intake, or by decreasing dry matter intake (DMI-100 to DMI-200) while maintaining average daily gain at different ration costs (\$100, \$150 or \$200/ton of DM) and fed-cattle prices.

efficiency obtained from increasing average daily gain are much more sensitive to increased fed cattle price than are improvements obtained from decreased dry matter intake. Generally, as cattle become more profitable, due to reduced ration cost or increased fed cattle price, the benefits of improved feed efficiency from increasing rate of gain, increase. As cattle become less profitable, due to increased ration cost, the benefits from improved feed efficiency obtained from decreasing dry matter intake, increase.

Economic benefits of improving feed efficiency by 0.12 resulting from increased average daily gain are also influenced by the number of days on feed and total weight gain during the finishing period. Improvement in feed efficiency caused by reduced dry matter intake and maintained rate of gain is also potentially impacted by days on feed because each day represents an incremental saving in feed, yardage and interest. To evaluate the impact of total weight gain and final weight, days on feed were altered in increments of 25 days so that final weight was 999, 1074, 1149 or 1224 lb (Figure 5). Ration cost (\$125/ton), purchase price of cattle (\$77.05/cwt), and selling price of fed cattle (\$71.61/cwt) were held constant. No attempt was made to differentiate between effects from days on feed and final weight.

**FIGURE 5:** Effects of final weight on the economic benefits of feed efficiency improvement obtained by increasing ADG or decreasing DMI.\*



\* 0.12 improvement in feed efficiency obtained by increasing average daily gain while maintaining dry matter intake, or by decreasing dry matter intake while maintaining average daily gain; ration cost of \$125/ton of dry matter.

Changes in final weight and days on feed had a greater impact on the benefits of enhanced average daily gain than on the benefits of decreased dry matter intake. Increasing the final weight from 999 to 1224 and days on feed from 83 to 158, respectively, improved the benefit of a 0.12 improvement in feed efficiency obtained from increasing average daily gain by \$3.26/hd (\$6.86/hd - \$3.60/hd). The same change in final weight and days on feed increased the benefit of improved feed efficiency from decreased dry matter intake by \$1.76/hd (\$3.68/hd - \$1.92/hd). Regardless of the final weight and days on feed of the cattle, improvements in feed efficiency obtained from increased average daily gain were of greater benefit than those noted from decreased dry matter intake when ration cost was fixed at \$125/ton. Improved feed efficiency obtained from increasing average daily gain or from decreasing dry matter intake was of similar benefit when ration costs were approximately \$237.50/ton, regardless of final weight.

Ration cost and fed cattle price were varied simultaneously to evaluate the interaction between final weight, ration cost and fed cattle price and improved feed efficiency from increased average daily gain or from decreased dry matter intake. Final weight did not have a dramatic impact on the ration cost where increased average daily gain and decreased dry matter intake were of equal benefit (data not shown).

## Implications

The economic benefits from improving average daily gain or feed efficiency can be separated because economic models developed with spreadsheets only use feed efficiency to calculate daily dry matter intake. So while the feed efficiency ratio includes both dry matter intake and rate of gain the model only uses feed efficiency to calculate daily dry matter intake. Improvements in feed efficiency obtained from decreasing dry matter intake while maintaining average daily gain or from increasing average daily gain while maintaining dry matter intake do not have the same economic benefit. Feed efficiency improvements obtained from enhancing average daily gain are influenced by the price of fed cattle to a much greater extent than by ration cost. Whereas, efficiency improvements obtained from decreasing dry matter intake while maintaining average daily gain are influenced by ration cost to a greater extent than by the price of fed cattle. Generally, as cattle become more profitable because of low ration cost or high fed cattle prices, improvements in feed efficiency obtained from increased average daily gain are of greater benefit than those obtained from decreased dry matter intake. If low fed cattle prices are not accompanied by high ration cost, improvements in feed efficiency obtained from increased average daily gain will be of similar or greater benefit than those from decreased dry matter intake.