Benchmarking Your Feed Efficiency, Feed Costs, and Income over Feed Cost

Michael F. Hutjens

Professor of Animal Sciences, University of Illinois, Urbana, 61801
Email: hutjensm@uiuc.edu

Take Home Messages

- Feed cost per kilogram of dry matter, feed cost per 45 kg of milk, income over feed costs, and feed efficiency provide valuable economic comparisons.
- Feed efficiency guidelines vary based on herd average, stage of lactation, and ration factors.
- Calculating feed efficiency can be measured and evaluated on dairy farms using on-farm measured values to calculate an adjusted feed efficiency (AFE).

Economic Benchmarking Your Feeding Program

A key measure when evaluating feeding changes is the impact on profitability. Several measurements are listed below for consideration. Each value can have advantages and disadvantages.

Feed cost per cow per day does not reflect milk yield, stage of lactation, or nutrient requirements. A target value in Illinois is less than $4.50 per cow per day for Holstein cows at 32 to 36 kg (70 to 80 lb) of milk. A better application of this value is calculate the ration components to determine if your costs are optimal for your herd's production and local feed costs (Table 1).

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Table 1. Illinois feed costs for a group of cows averaging 31.8 kg (70 lb) of milk.

Feed	DMI (kg/day)	Cost ($/kg)	Total Cost ($/day)
Forages	12.7	0.132	1.68
Grain Energy	4.5	0.154	0.70
Protein Supplement	2.3	0.22	0.50
By-Product Feed	2.7	0.22	0.60
Min/Vit/Additives	0.45		0.30
Feed Consultant			0.10
Totals	22.		$3.98

Feed cost per kilogram of dry matter is a useful term when comparing similar regions, breeds, and levels of milk production. A target value in Illinois is less than 17.6 cents per kg (eight cents per lb) of dry matter. In Table 1 the cost is 17.6 cents per kg of dry matter. This value reflects feed ingredient selection and feed additive inclusion.

Feed cost per 45 kg (100 lb) of milk has the advantage of standardizing milk yield allowing for comparisons between groups and farms within a region. Milk yield per cow, feed shrink, weigh backs, and feed costs will impact this value. A target value in Illinois is less than $5.50 per 45 kg for Holstein cows (Table 1 range is $4.97 to $5.59).

Income over feed costs (IOFC) is a popular value as it provides a benchmark for herd or groups of cows reflecting profitability, current feed prices, and actual milk prices. If dairy managers have calculated fixed costs and other variable costs, IOFC can be used to determine breakeven prices, optimal dry off time, and culling strategies. A target value in Illinois is over $10.00 per cow per day ($0.33 kg). The example in Table 1 is 8.31 to $9.03 per cow per day.

Marginal milk response reflects the profit if additional kilogram of milk can be achieved. Generally, this approach is profitable if cows respond to the feeding change because maintenance costs and fixed costs have been covered by previous milk production. For example if adding one kilogram of dry matter increases milk yield by two kilograms milk valued at 66 cents ($0.33 kg) and dry matter at 17.6 cents, the marginal milk profit is 48 cents.

Cost per unit of nutrient allows dairy managers to compare the relative cost of a selected nutrient. If corn is priced at $0.15 per kg (dry matter basis), one unit of net energy is worth $0.065 cents per Mcal of net energy. If corn is the base energy feed resource; then forages, by-product feeds, and other cereal grains can be compared on their cost per unit of target nutrient.

Feed efficiency (FE) can be defined as kilograms of fat correct or energy corrected milk produced per kg of dry matter intake (DMI) consumed. In Table 1, the value was 1.4 kg and 1.6 kg of 3.5% milk per kg of feed dry matter consumed. Guidelines for FE are listed in Table 2. Table 3 has FE guidelines based on herd milk yield.

Table 2. Benchmarks for feed efficiency comparisons.

Group Milk/kg DM	Days in Milk	FE (kg milk/kg DM)
One group, all cows	150 to 225	1.4 to 1.6
1st lactation group	< 90	1.5 to 1.7
1st lactation group	> 200	1.2 to 1.4
2nd + lactation group	< 90	1.6 to 1.8
2nd + lactation group	> 200	1.3 to 1.5
Fresh cow group	< 21	1.3 to 1.6

Table 3. Target FE based on rolling herd average and milk yield per cow (St. Pierre, 2008)

Rolling herd average (kg/lb)	FE	Milk yield per cow (kg/lb per day)	FE
8,182/18,000	1.24	25.0/55	1.25
9,091/20,000	1.32	29.5/65	1.38
10,000/22,000	1.40	34.1/75	1.49
10,909/24,000	1.47	36.4/80	1.54
12,727/28,000	1.58	38.6/85	1.58
13,636/30,000	1.63	40.9/90	1.63

■ Using Feed Efficiency as a Tool

Feed efficiency (also referred to as dairy efficiency) can be defined as kilograms of 3.5% FCM (fat corrected milk) produced per kilogram of dry matter (DM) consumed. Monitoring FE in the dairy industry has not been used as a common benchmark for monitoring profitability and evaluating dry matter intake relative to milk yield. The "traditional focus" was that as cows consumed more feed to support higher milk production, the proportion of digested nutrients captured as milk is proportionally higher.

Accurate feed intake is critical for an accurate FE value. Feed refusals should be removed (subtracted) as this feed has not been consumed. Weekly dry matter tests should be conducted on the farm to correct for variation in DMI due to changes in wet feeds or precipitation.

Correct for milk components as more nutrients are needed as milk fat and protein content increases. Values reported in this paper are based on 3.5 %FCM. The following formulas can be used:

Equation 1: 3.5% kg FCM = (0.4324 x kg of milk) + (16.216 x kg of milk fat)

Equation 2: 3.5% kg energy corrected milk = (12.82 x kg fat) + (7.13 x kg protein) + (0.323 x kg of milk)

On Holstein farms, use the thumb rule of adding or subtracting 0.45 kg (1 lb) of milk for every one-tenth percentage point change above or below 3.5 percent fat test. For example, if a herd averages 31.8 kg (70 lb) of milk with a 3.9 percent milk fat, the estimated kilograms of 3.5% FCM would be 33.6 kg instead of 31.8 kg.

The economic impact of feed efficiency is another key factor when shifting FE values. If a herd or group of cows producing 32 kg of milk (70 lb) of milk with a FE of 1.4 (22.7 kg of DMI) changes to a FE of 1.6, the average DMI drops to 19.9 kg (43.8 lb). If dry matter is valued at 17.2 cents per kg, this improvement in FE results in a savings of 49 cents per cow per day or 24 cents per 0.1 point increase in FE.

■ Measuring FE on Dairy Farms

Option 1. Computer software program. FED (Feed Efficiency Determinator) was developed by Zinpro Corporation and is available for field application. The software program allows on-farm data that will standardize FE values (similar to management level milk or 150 day milk). Using spreadsheets, managers could enter days in milk, body weight, milk yield, milk fat test, milk

protein test, changes in body condition score, environmental temperature, walking distances, and lactation number using research-based and NRC 2001 equations to adjust values. Several detailed measurements and complete herd data are needed to use the computer software.

Option 2. On-farm measurement of FE. This approach collects dry matter intake by group or herd using actual feed amount delivered with automated computer tracking systems (such as Feed Tracker), subtracting feed refusals, and collecting daily milk yield using a group total (such as in-line milk meters) or individual cow production summaries. A Wisconsin herd FE results are summarized in Table 4..

Table 4. Feed efficiencies in a commercial herd in Wisconsin based on age and days in milk.

Group	DIM (days)	Milk (kg)	DMI (kg)	FE (kg/kg)
1st Fresh	27	19.1	22.0	0.87
1st High	124	35.9	22.7	1.58
1st Preg	225	29.1	24.1	1.21
2nd Fresh	20	27.2	23.6	1.15
2nd High	80	45.9	26.4	1.74
2nd Preg	276	30.5	23.2	1.31

Option 3. AFE (adjusted feed efficiency) can be calculated by dairy managers and nutritionists using available data in a simplified approach with the following situations or limitations.

- Milk yield is available monthly from DHI or daily bulk tank yields.
- Feed intake by groups or herd is not recorded daily. A feed sheet or ration may be available.
- Weigh backs may or may not be measured.
- No group or pen milk components are available.

The following factors can be used along with bulk tank milk yields and ration summaries to estimate the impact values on AFE. Nutritionists and dairy managers can use the ten factors below to illustrate the impact these management and heath adjustments can have on AFE (modify factors and numeric values as desired).

Factor 1: Weigh backs. Estimations of feed refusals can use a bunk scoring system based on a subjective estimate.

Feed bunk score 0 has no feed remaining

Feed bunk score 1 has 1 percent remaining

Feed bunk score 4 has 4 percent remaining

If a bunk reading was scored 4 with delivered dry matter of 25 kg per cow, the weigh back could represent 1.0 kg.

Factor 2: Days in milk (DIM). Reduce 0.11 FE unit for each additional 30 days starting at 150 DIM.

Factor 3: Somatic cell count. For each linear score increase or decrease in SCC, add I kg of milk to the current herd production. If our example herd was linear score 4, reducing linear SCC to 3 could increase milk yield by 1.0 kg.

Factor 4: Change in body condition. If cows are gaining one half body condition score, the energy stored as body weight can represent 60 kg of milk production. If this weight gain occurs over 120 days, this is equivalent to 0.5 kg of additional milk production.

Factor 5: Exercise/pasture. If cows walk 800 meters per day (two times a day milking and/or walking to pasture resulting in four trips a day averaging 200 meters per trip) this can increase maintenance requirements by 1.9 Mcal which is equal to 2.1 kg of milk.

Factor 6: Rumen acidosis. Field reports estimate that FE may drop 0.1 unit if cows experience sub-acute rumen acidosis (SARA). Diagnosis could be based on the following field indicators.

- Milk protein: milk fat ratios (over 0.9 or 3.2 total milk protein test and 3.3 milk fat test)
- Loose manure (average manure scores under 2.5)
- Average lameness score over 1.6 (1 to 5 point scale)
- Dry matter intake varies over one kg per cow per day

Factor 7: Protein level and form. Illinois data indicated that the level of protein can impact FE. As diets increased from 16.8 to 18.7% crude protein FE decreased by 0.03 units. An animal protein blend increased FE by 0.07 units compared to a soybean meal control source.

Factor 8: Feed additive. Adding yeast culture/yeast, an ionophore, buffers, and direct-fed microbials may increase FE by 0.05 to 0.10 units per additive

added.

Factor 9: Fiber level. As NDF (neutral detergent fiber) percent in the ration dry matter increased, FE declined from 1.8 to 1.4 based on Journal of Dairy Science data from 2002 to 2004. FE values remained constant at 35% NDF and above.

Factor 10. Heat stress. If cows are exposed to heat stress with no heat abatement intervention, the following declines in FE can occur due to higher maintenance requirements, lower milk yield, and lower feed intake:

Cows exposed to 86^{o} F compared to 68^{o} F, reduce FE by 0.1 units.

Cows exposed to 95^{o} F compared to 86^{o} F, lower FE by 0.3 units.

■ Fresh Cow Monitoring of FE

For dairy managers and nutritionists with accurate fresh cow pen data (daily milk yields, group feed intakes, and days in milk), FE is a useful tool to monitor dry matter intake after calving, to compare heifer and mature cow fresh pens, and to monitor the success of the transition program. A California field study of 50 herds reported the FE for the following groups of cows (days in milk was not reported).

- Heifer fresh cow group average 1.47 with a range of 1.19 to 1.87
- Cow fresh cow pen averaged 1.75 with a range of 1.26 to 2.26

A low FE can be positive if dry matter intake after calving is high due to a solid transition feeding program which can support milk production increases without excessive weight loss. However, low FE after calving can lead to low milk production in early lactation, a potential problem. A high FE can indicate cows are achieving high milk after calving (good) with low dry matter intake after calving (bad), leading to excess weight loss, ketosis, and fatty liver development.

■ Summary

Calculating various feeding metrics is a must for dairy managers to evaluate if their feeding program competes as a cost of doing business. Each measurement reflects decisions on feed purchased, forage quality produced, milk yield and components, and feed conversion to milk. Dairy managers control this aspect of their management program, which represents 40 to 60 percent of the costs to produce milk. If you can not measure the feed factors, you can not manage the results.

Selected References

Casper, D, L Whitlock, D. Schauff, and D. Jones. 2003. Feed efficiency boosts profitability. Hoard's Dairyman Magazine. Sept 25.

Casper, D.P., L. Whitlock, D. Schauff, D. Jones, and D. Spangler. 2004. Feed efficiency is driven by dry matter intake. J. Dairy Sci. 87 (Suppl. 1):462, Abstract 933.

Hutjens, M.F. 2007. Practical approaches to feed efficiency and applications on the farm. Proc. 2007 Penn State Dairy Nutrition Workshop. Penn State Univ.

Hutjens, M.F. 2005. Feed efficiency and its impact in large dairy herd. Southwest Nutritional Conf Proc.

Linn, J, T., M. Raeth-Knight and N. Litherland. 2009. Role of feed (dairy) efficiency in dairy management. Proc. of Pacific Northwest Nutr. Conf.

St-Pierre, N. 2008. Managing measures of feed costs: Benchmarking physical and economical feed efficiency. Proc. Tri-State Dairy Nutr. Conf. Fort Wayne, IN

Wang, S, G.L. Roy, A.J. Lee, A.J McAlliser, T.R. Batra, and C.Y. Lin. 1992. Evaluation of various measurements of and factors influencing feed efficiency in dairy cattle. J. Dairy Sci. 75:1273-1280