Dairy Grazing

Economics of Pasture-Based Dairies

Understanding the financial risks and rewards of pasture-based dairying is important for dairy farmers. The development of a new dairy or expansion of an existing one must be carefully considered to determine if it will create the economic returns needed to sustain any debt, family living and profits to owners. Most decisions on a dairy will have financial implications and need to be based on sound production and financial information. Maintaining records and monitoring appropriate benchmarks can help a farmer understand the state of the dairy and improve its financial performance.

Dairy grazing publication series

This publication is one in a series about operating and managing a pasture-based dairy. Although these publications often refer to conditions in Missouri, many of the principles and concepts described may apply to operations throughout the United States. A list of the publications in this series is available online at ***http://extension.missouri.edu/m168***.

Economic data from the University of Missouri Southwest Center Dairy

The University of Missouri (MU) developed a pasture-based dairy in Mt. Vernon, Mo., in 1998. The dairy was developed to serve as a regional demonstration and research facility to promote grass-based dairying. The farm began with a 50-cow herd and by 2010 had about 120 crossbred cows. The farm has a seasonal spring calving herd. Milk production levels have typically been between 11,000 and 13,500 pounds per cow per year.

Financial information for the University of Missouri dairy has been kept each year since 1999. Tables 1 and 2 report the economic summaries for the latest five years on a cow and a hundredweight (cwt) basis, respectively. Note that certain expenses, indicated with an asterisks (*), were supplied by local pasture-based dairy producers because the university farm's information was not representative of what could be expected on a dairy its size. Additionally, heifer costs were not included in this analysis. The operating margin, as calculated in these records, represents the surplus of income over expenses that the producer has available to pay debts (principal and interest repayments), make capital replacements including heifers, cover depreciation and provide for family living.

The most important observation that can be made from these financial summaries is that the two primary drivers of profit are the cost of feed and the price of milk. Given that dairy farmers have very little impact on the price of milk (although we encourage producers to take advantage of milk price protection services), they need to focus on controlling costs in grazing dairies.

Feed costs represent about half of the total operating cost of production on a pasture-based dairy. High-quality pasture is an important substitute feed source. Pasture is the least costly feed source available on a farm. High-quality pasture costs from 2 to 4 cents per pound of dry matter. Farms with the lowest production costs typically use fresh, high-quality pasture at a high rate. The cows and paddocks are managed to ensure quality forage is available to the cows as many days as possible during the milking season. Excess forage is usually baled into baleage. This baleage can be used during the winter or periods of drought when high-quality forage may not be available. Some producers, however, prefer corn silage as a feed source during these times. Silage typically costs 6 to 8 cents per pound of dry matter and good alfalfa hay 8 to 10 cents per pound of dry matter. The most expensive feed source is concentrate feed delivered to the bulk bin, which usually costs 12 cents or more per pound of dry matter. The combination of feed cost control and optimal milk production is a major driver in the profitability of a pasture-based dairy.

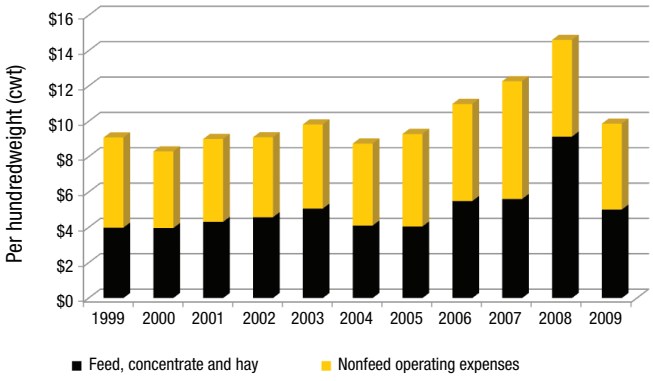

Figure 1. MU Southwest Center Dairy operating expenses: Feed vs. nonfeed (per cwt).

Revised from M168, *Dairy Grazing Manual*, by
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Table 1. Average income and expenditures per cow from MU Southwest Center Dairy.

	2005	2006	2007	2008	2009	5-year average
Milk price	$15.99	$13.57	$20.85	$20.86	$14.07	$17.07
Production	12,940	11,906	11,279	11,302	10,486	11,583
Income						
Milk sales	$2,070	$1,616	$2,352	$2,358	$1,475	$1,974
Cattle sales	$224	$90	$243	$198	$205	$192
Misc./Dividends	$3	$243	$0	$0	$0	$49
Total income	$2,297	$1,949	$2,595	$2,556	$1,680	$2,215
Expenses						
Concentrates	$352	$352	$429	$577	$373	$417
Harvested forages	$173	$302	$204	$456	$152	$257
Hired labor*	$98	$90	$95	$95	$86	$93
Rent	$0	$0	$0	$0	$0	$0
DHIA	$18	$18	$18	$18	$5	$15
Semen/Breeding	$43	$21	$64	$48	$29	$41
R.E./P.P. taxes*	$12	$14	$10	$10	$24	$14
Milk marketing	$100	$131	$116	$129	$102	$116
Repairs/Truck*/Fuel*	$104	$71	$77	$88	$61	$80
Vet/Med	$38	$56	$28	$30	$49	$40
Parlor supplies	$70	$62	$58	$45	$23	$52
Utilities	$43	$42	$62	$38	$60	$49
Insurance*	$20	$14	$18	$18	$12	$16
Misc.	$13	$25	$58	$31	$4	$26
Fertilizer	$45	$47	$53	$37	$33	$43
Seed/Spray	$26	$46	$41	$23	$8	$29
Custom hire*	$33	$3	$11	$0	$3	$10
Fence/Water	$14	$14	$42	$8	$12	$18
Total expenses	$1,202	$1,308	$1,384	$1,651	$1,035	$1,316
Operating margin before interest	$1,095	$641	$1,211	$905	$646	$900

** Expenses obtained from local dairy graziers.*
Note: Heifer expenses are not included in this summary.

Labor is typically the second largest cost on a pasture-based dairy. Labor comprises full-time employees and part-time employees, such as relief milkers. Unproductive or underproductive labor can become a cash drain instead of a cash producer for the farm, so the number of full-time equivalent (FTE) employees required for the farm to be productive and efficient needs to be evaluated.

In addition to feed and labor costs, other costs can affect overall profitability of a pasture-based dairy farm. A dairy manager must identify and understand the dairy's key operating costs. Key operating costs are critical to the farm's success. They are the costs that a manager can influence the most and that have the greatest impact on profitability.

Missouri dairy models

The following series of minimalist, start-up pasture-based dairy model farms (75-cow, 150-cow, 300-cow and 600-cow), reflecting costs and conditions as of October 2010, were developed by the University of Missouri to help current and potential dairy producers discuss and evaluate the economics of these operations. These models were developed using assumptions, costs and benchmarking information from existing Missouri pasture-based dairies and experts in the dairy industry. Although these farms were customized specific to Missouri, they could be adapted regionally in the U.S.

Farm location

The model farms assume a carefully selected parcel of land purchased specifically for developing a minimalist pasture-based dairy. Careful farm selection is critical to the amount of investment needed and to enable future low operating costs. To avoid investments in livestock housing, the farm site must have well-drained soils with some timber or brush for cover during the worst winter conditions. To keep feed costs low, the dairy needs mostly open ground with productive soils that can be managed for high-producing pastures that can be replanted with annual forage and improved perennial forage varieties.

Table 2. Average income and expenditures per hundredweight (cwt) from MU Southwest Center Dairy.

	2005	2006	2007	2008	2009	5-year average
Income						
Milk sales	$16.00	$13.57	$20.85	$20.86	$14.07	$17.07
Cattle sales	$1.73	$0.76	$2.15	$1.75	$1.96	$1.67
Misc./Dividends	$0.02	$2.04	$0.00	$0.00	$0.00	$0.41
Total Income	$17.75	$16.37	$23.01	$22.62	$16.03	$19.15
Expenses						
Concentrates	$2.72	$2.96	$3.80	$5.11	$3.56	$3.63
Harvested forages	$1.34	$2.54	$1.81	$4.03	$1.45	$2.23
Hired labor*	$0.76	$0.76	$0.84	$0.84	$0.82	$0.80
Rent	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
DHIA	$0.14	$0.15	$0.16	$0.16	$0.05	$0.13
Semen/Breeding	$0.33	$0.18	$0.57	$0.42	$0.27	$0.35
R.E./P.P. taxes*	$0.09	$0.12	$0.09	$0.09	$0.23	$0.12
Milk marketing	$0.77	$1.10	$1.03	$1.14	$0.97	$1.00
Repairs/Truck*/Fuel*	$0.80	$0.60	$0.68	$0.78	$0.58	$0.69
Vet/Med	$0.29	$0.47	$0.25	$0.27	$0.46	$0.35
Parlor supplies	$0.54	$0.52	$0.51	$0.40	$0.22	$0.44
Utilities	$0.33	$0.35	$0.55	$0.34	$0.57	$0.43
Insurance*	$0.15	$0.12	$0.16	$0.16	$0.12	$0.14
Misc.	$0.10	$0.21	$0.51	$0.27	$0.04	$0.23
Fertilizer	$0.35	$0.39	$0.47	$0.33	$0.31	$0.37
Seed/Spray	$0.20	$0.39	$0.36	$0.20	$0.08	$0.25
Custom hire*	$0.26	$0.03	$0.10	$0.00	$0.02	$0.08
Fence/Water	$0.11	$0.12	$0.37	$0.07	$0.11	$0.16
Total expenses	$9.29	$10.99	$12.27	$14.61	$9.87	$11.40
Operating margin before interest	$8.46	$5.38	$10.74	$8.01	$6.16	$7.75

** Expenses obtained from local dairy graziers.*
Note: Heifer expenses are not included in this summary.

Herd management

The beginning herd in the model farms is assumed to contain only purchased crossbred dairy heifers. Because U.S. dairies have only recently started deliberately cross-breeding cattle to produce milk under intensive managed rotational grazing systems, a higher cull rate is assumed at startup. Cows are expected to be culled from the herd based on involuntary factors such as death, disease, problem breeders and high somatic cell counts, and voluntary factors such as low milk production and disposition.

Projected cull cows sold, death losses and calving intervals are listed in Table 3. The models assume that the average culls sold, both voluntary and involuntary, would gradually decline over the first five years of operation. The death loss rate is estimated to be 4 percent in all years. The total herd turnover rate, including deaths, would begin at 29 percent and gradually fall until reaching a steady rate of 22 percent by year five.

This dairy system is built around a seasonal grass-based dairy concept with a 12-month calving interval. When starting a dairy using purchased genetics selected for high production, however, a few years of transition will be needed. In the first year of production, many heifers will enter the herd but not rebreed within the window to remain seasonal. They will be rebred eventually, but outside the window necessary to calve seasonally. These animals can be sold as breeding stock to dairy producers with different calving seasons, allowing the dairy to cull as needed for reproduction without having to sell all of the cull cows for slaughter. Over time, the whole herd calving interval will drop as the hard breeders are selected out of the herd. By year four, the calving interval is expected to decline to 12.8

Table 3. Herd turnover and mortality rates.

	Year				
Description	**1**	**2**	**3**	**4**	**5**
Annual culls sold (percent)	25	22	20	18	18
Annual death loss (percent)	4	4	4	4	4
Total cull rate	29	26	24	22	22
Calving interval (months)	14.0	13.5	13.0	12.8	12.8

months. Further improvement may be expected as genetic crosses with higher reproductive performance continually enter the herd. Crossbred dairy cows are used in grazing dairy systems because of their ability to better use pasture, their higher reproductive efficiency and their overall hybrid vigor.

In the model farms, all calves are assumed to be sold within one week of birth to a contract heifer grower and bought back from the contract heifer grower later. Heifer-raising expenses can have a major detrimental impact on cash flow within the first two years if a new dairy is trying to buy replacements, pay off cattle loans and raise a big group of its own replacements. In the model farms, all heifer calves will be sold for $250, bull calves will be sold for $75 and prefresh replacement heifers will be bought back for $1,250.

Annual milk production and the rolling herd average were estimated for the model farms. Of that volume of milk, 95 percent is assumed to be marketed and 5 percent is assumed to be discarded or consumed by bull calves because it is coming from fresh or treated cows.

Table 4. Daily milk production and rolling herd averages.

	Year				
Description	**1**	**2**	**3**	**4**	**5**
Pounds per day	38.0	44.0	45.0	45.0	45.0
365-day rolling herd average	10,999	12,736	12,894	12,825	12,825

Supplementary feeds were designed to complement the characteristics of the pasture forage at a reasonable cost. The model farms purchased hay and concentrate. Twelve pounds of concentrate, costing $200 per ton delivered, is fed per cow in the parlor for the milking group. An average of 5 pounds of purchased hay or silage costing 8 cents per pound of dry matter is fed. Parts of the year this supplementary feed may not be needed, but at the beginning and end of the season more will be fed to the milking group. The dry cow group is fed 5 pounds of concentrate costing 9 cents a pound and 20 pounds of purchased hay at 4.5 cents a pound as needed throughout the dry period.

Table 5. Daily purchased feed costs per cow for the milking period.

Description	**Cost/Cow/Day**
Purchased concentrates	$1.00
Purchased hay	$0.40
Feed cost/cow/day	$1.40

Table 6. Daily purchased feed costs per cow for the dry cow period.

Description	**Cost/Cow/Day**
Purchased concentrates	$0.45
Purchased hay	$0.90
Feed cost/cow/day	$1.35

Milk marketing

Various factors were considered in developing a projected milk price. Class III price is the most widely used national benchmark price. Class III prices represent the milk used to make cheese, the predominate use of milk in the U.S. In the economic models, basis (difference between local cash price and futures price) is assumed to be $2.66 per cwt in Missouri, based on historical prices at the MU Southwest Center Dairy. Basis can be calculated for a specific operation using the difference between the farm pay prices and Class III milk prices over a historical period. Premiums may be expected on a pasture-based dairy. Premiums that can be expected on a pasture-based dairy arise from having low somatic cell counts (SCC) and high butterfat and protein components.

Financial projections in these models use a farm-level gross milk price ranging from $17.19 to $17.45 per cwt (see Table 7) and an average Class III milk price of $14.50. Hauling and volume premiums were varied by the size of the operation. These price levels were considered realistic based on long-term historical milk prices and relationships in Missouri.

Table 7. Estimated Missouri milk price for various size dairy herds.

	Operation size			
Description	**75-cow**	**150-cow**	**300-cow**	**600-cow**
Class III average price	$14.50	$14.50	$14.50	$14.50
Long-term basis in Missouri	$2.66	$2.66	$2.66	$2.66
Hauling premium	$0.03	$0.08	$0.09	$0.09
Volume premium	$0.00	$0.00	$0.20	$0.20
Gross milk price per cwt	$17.19	$17.24	$17.45	$17.45

Futures markets exist for Class III milk and are the most liquid of the dairy contracts used for hedging. As the futures basis becomes more predictable, risk management strategies such as forward price contracts and futures/options may be used to lower price volatility. Dairy producers should continually evaluate market conditions to seek the most profitable and secure choice for their milk marketing.

Marketing costs deducted from the gross milk price in the model farms were CWT assessment (10 cents per cwt), advertising (15 cents per cwt), coop fee (10 cents per cwt) and hauling (80 cents per cwt).

Labor management

A grazing dairy that milks twice daily will ideally plan to spend no more than 2.5 hours in the parlor per milking. It will also outsource any necessary forage harvest and heifer development to keep labor costs low. Labor efficiency is important on a pasture-based dairy, as labor represents one of the highest operating costs. Benefits cost for all labor is assumed to be only the employer's share of Social Security and Medicare taxes. Hourly labor was based on a $12-per-hour rate in year one and the manager's salary was increased

Table 8. Projected labor summary for various size dairy herds (5-year averages).

Description	Operation size			
	75-cow	150-cow	300-cow	600-cow
Hired labor hours	4,368	5,408	7,280	10,400
FTEs (based on labor hours)	2.1	2.6	3.5	5.0
Pounds of milk per FTE	423,301	683,794	1,015,923	1,422,292
Annual benefits	$2,413	$4,221	$7,634	$10,545
Total hourly labor	$0	$13,120	$52,479	$85,279
Total salaried labor	$31,538	$42,051	$47,307	$52,563
Total labor cost	$33,951	$59,391	$107,420	$148,387

Table 9. Capital investments for various size dairy herds.

Description	Operation size			
	75-cow	150-cow	300-cow	600-cow
Land ($2,000 per acre)	$130,000	$240,000	$480,000	$920,000
Dairy cows ($1,250 per cow)	$93,750	$187,500	$375,000	$750,000
Buildings and farm setup	$253,582	$280,632	$499,440	$894,278
Machinery and equipment	$124,500	$124,500	$164,500	$188,200
Total investment	$601,833	$832,632	$1,518,940	$2,752,478
Investment per cow	$8,024	$5,550	$5,063	$4,587

incrementally based on herd size due to additional responsibilities. A 2.5 percent inflation rate is built into all of the labor and operating expenses.

Capital investments

Capital investments for a pasture-based dairy operation include land, real estate, machinery, equipment and livestock. The character of the investments in a pasture-based dairy reduces the lender risk because a high percentage of the initial investment is concentrated in appreciating land and reproducing cattle rather than specialized assets that are harder to liquidate at full value.

The financial success of a grazing dairy depends on keeping the capital investment and the operating expenses low. Careful farm selection is critical both to the amount of investment needed and to enabling future low operating costs. Stocking rates for the model farms was assumed at 1.35 cows per acre, and 9 to 15 acres (depending on operation size) dedicated to the farmstead/facilities, lanes and waste ground. Table 9 details the major investment categories necessary to make each size dairy farm operational.

Investments in the milking center include a milking parlor, milking equipment, holding area, utility room, milk room, rest rooms and tanks. Milking equipment includes parabone stalls designed for rapid cow flow, a flush system for the parlor, automatic take-offs, plate cooler and a heater. Different size parlors were assumed in the economic models based on herd sizes.

- 75-cow operation — Swing 12 parabone parlor
- 150-cow operation — Swing 12 parabone parlor
- 300-cow operation — Swing 24 parabone parlor
- 600-cow operation — Swing 50 parabone parlor

Most graziers want an inexpensive, efficient facility that can be updated or improved as cash flow permits. Ultimately, they want a parlor large enough to allow them to complete each milking in 2.5 hours. In the model farms, parabone swing parlors were used to promote production efficiency by emphasizing cow comfort, cow movement and efficient labor usage.

Permanent lanes, water lines and paddocks are established in these dairies. Lanes are essential in a pasture-based dairy to move cows easily from pasture to parlor, whether the grazing cell design is fixed or flexible. Constructing raised lanes with adequate drainage capacity and made of crushed rock, lime screenings or other stabilizing material reduces annual maintenance needs and keeps cows cleaner and healthier. Electrified 12.5-gauge high-tensile wire was used for perimeter fence and permanent paddock fencing in this dairy system. Water systems in the investments include buried waterlines and permanently installed tanks.

Initial expenses of forage establishment are also factored in the capital investments. These expenses include fertilizer, seed and tillage. Pastures can be seeded either on a prepared seedbed or by no-till drilling, depending on site conditions and crop requirements.

Machinery investments include tractors, pickup, ATVs, silage feeding wagon and other farm equipment. Other facility investments include equipment storage, hay barn and feed bins. Such investments will vary by operation size.

Financial analysis of pasture-based dairy models

The financial analysis for the pasture-based model farms assumes 100 percent equity, with no debt. Although unrealistic, this simplifying assumption allows producers and lenders to quickly analyze the free cash flow to determine how much debt the operation will support.

Based on the underlying assumptions previously discussed, a financial analysis was developed for each Missouri dairy model farm (Table 10). Note that the financial parameters are averaged over five years, with lower financial performance in the first few years and improved performance in years four and five. Economies of scale are demonstrated with higher returns suggested for the larger operations.

The following discussion focuses on the results for the 150-cow operation model because most dairy families can supply the adequate labor for that size dairy. The 150-cow model dairy grosses $328,248 per year in milk and young stock sales. It nets $47,842 after all operating costs, labor and depreciation are deducted. On a per cow basis, this is a gross operating income of $2,188 per cow and a net operating income of $319 per cow, after labor and depreciation are deducted.

Table 10. Financial analysis for various size dairy herds (5-year averages).

	Operation size			
Description	**75-cow**	**150-cow**	**300-cow**	**600-cow**
Total gross revenue	$163,680	$328,248	$663,964	$1,327,927
Total operating expenses (including depreciation)	$160,837	$280,407	$533,652	$974,514
Net farm income	$2,843	$47,842	$130,311	$353,413
Net cash flow	$35,341	$80,213	$179,256	$424,965
Operating expense ratio	74.1%	71.2%	68.7%	63.7%
Return on assets	0.6%	6.3%	9.1%	13.2%

Adding net income from operations plus the building and machinery depreciation yields a free cash flow available for principal and interest payments. This free cash flow estimate assumes no cash will be used for family living expenses other than what is already used to pay labor in the dairy.

Conversion of an existing dairy

Another option for dairy producers wanting to reduce initial capital investments is to buy a farm with an existing milking facility and modify the farm into a pasture-based dairy. Farm buyers may come across an opportunity to buy a dairy without paying extra for an obsolete milking parlor. Many successful pasture-based dairy producers have renovated an existing parlor with minimal investments. An example renovation would be converting an existing double 4 herringbone parlor to a swing 12 parabone parlor. This option is one strategy for overcoming the capital threshold that can be a barrier for smaller pasture-based dairies.

Dairy report card

For a dairy farm to be profitable, the farmer needs to understand the contribution of each major and minor cost input to overall profitability and to develop appropriate record systems to track the financial and physical aspects of the operation. Proper record systems provide the farmer with the appropriate information to make sound decisions, thus adding to the success of the farming operation.

As a farm increases in size and scope, the farmer must make decisions that have large impacts on the farm business and the future of his or her family and other investors. To ensure the farm's continued success, the farmer needs to be able to quickly identify potential issues. To be able to do this, the farmer must develop a set of evaluation indicators, set benchmarks for them and regularly monitor them. The farmer needs to understand the impact these indicators have on the business so that issues can be readily identified and the proper adjustments made on either the production or business level.

Benchmarking allows a farmer to quickly evaluate a situation and make necessary adjustments. Benchmarking has two important components:

- Comparing the farm performance over time in relation to the set targets
- Comparing key performance indicators (KPIs) with those of others in the same field to determine if others are making improvements at the same rate

KPIs for a pasture-based dairy farm are quantifiable measurements that reflect the critical success factors. KPIs are calculated for an individual farm and are valuable in tracking the farm's performance. They reveal a high-level overview of the farm. The farm's goals, which are dependent upon its mission and stakeholders (owners, employees, lenders and others), must be identified before any KPIs are selected. To be a KPI, an indicator must be critical to the success of the farm and a solid indicator of progress. KPIs are expressed by defining what is to be measured and describing how it is to be measured. Traditionally, KPIs have dealt with production issues faced on a confinement farm, but a combination of financial and production measures better determines what is occurring on a pasture-based dairy farm.

KPIs are most successful when used to evaluate the success of a department or system. For example, in evaluating the breeding program, "percent calved within the window" might be useful to measure the *efficiency* of the breeding program, but it does not reflect the "percentage of cows bred." To better understand the *entire* breeding program, "percent calved" might be a better measure. Several standard measures are used to evaluate success, but in the end, the owners and the management team ultimately determine which KPIs to use.

Successful use of KPIs to improve pasture-based dairy business management begins with a three-step process.

1. Determine what areas of the business will be evaluated.
2. Select KPIs to measure, and establish goals for each indicator.
3. Develop a simple reporting and monitoring system for each indicator.

Developing a simple process is important because if data cannot be collected easily and computed accurately, it is of no practical use. Reports must show results compared with the goals established for each indicator in each department. When all indicators have been calculated, a "dairy report card" should be developed and provided to dairy operators and owners who can immediately prioritize their activities to focus on tasks for farm improvement.

Several physical and financial KPIs exist for pasture-based dairy farmers to use on their operations. The following sections discuss some of those indicators.

Physical KPIs

Physical KPIs relate directly to the production systems on the farm itself. These KPIs can be used to evaluate the performance of the grass and the management of the forage resources. Physical indicators give the farmer an indication of the farm's cost of production.

Grazing wedge

Managing for the highest quality and quantity of forage available is critical to the overall success of a farm. A grazing wedge enables the farmer to understand the forage conditions on the farm, including the quantity available today and in the future. It also helps the farmer determine what paddocks to graze, fertilize or mechanically harvest.

A grazing wedge is a visual representation of the dry matter available in each paddock. It depicts the quality and quantity of forage dry matter available both now and during the next round of grazing.

Weekly forage measurements are needed to create a grazing wedge. (The University of Missouri has developed an online grazing wedge calculator that farmers can use to develop their grazing wedges: ***http://grazingwedge.missouri.edu***.)

Stocking rate

Stocking rate is simply the number of cows divided by the effective acres on the milking platform (total acres used to directly support dairy cows). Stocking rate is one measure of grass productivity and grass use. Depending on the farmer's management ability and the forage system, stocking rates should range from 1 to 1.5 cows per acre on most pasture-based dairy farms. The ultimate challenge is to replace as much concentrate as possible with cow-harvested forage, while maintaining grass quality.

Milk per acre and per cow

Because the stocking rate can vary greatly between farms, an alternative measure is to calculate the milk production (pounds) per acre by dividing the total milk production by the milking platform. This measure can lead to the determination of income and, ultimately, net profit per acre. It allows the farmer to evaluate overall farm productivity.

Milk production per cow is determined by dividing the total pounds of milk produced by the peak number of cows milked. This measure indicates the cow productivity given the grazing and feeding program on the farm. Milk production on most pasture-based dairy operations in Missouri tends to range from 10,000 to 16,000 pounds per cow, which varies depending on herd genetics, quantity of high-quality forage available, quantity of concentrates in the total ration and whether the dairy is seasonal.

Tons of dry matter used per acre

Using the forage produced on the farm as either standing forage, harvested baleage or hay is less costly than purchasing feed from off-farm. The measure of tons of dry matter used per acre shows farm productivity over all pasture forage management and cow management. Baleage is usually less costly than concentrates, providing yet another incentive to use as much forage from the farm as possible.

Pre- and post-grazing measurements

Tracking how much forage is being grazed in a paddock is as easy as calculating the difference between the pre-grazing measurement and the post-grazing measurement. Knowing how much the cows are consuming allows the farm manager to better understand the cows' intakes and balance the total ration. The pre-grazing measurement is also an indication of the quality of forage being grazed.

Pounds of feed per cow per day

The cost of concentrates is three to four times the cost of high-quality pasture. The daily cost of feed being delivered to the bunk is an indicator of how well the grass is being managed and of total cost of production. Concentrate feeding levels will vary depending on the availability of quality forage throughout the grass season.

Pounds of milk per full-time equivalent (FTE)

Pounds of milk per FTE is a measure of labor efficiency on a pasture-based dairy. This measure is scale dependent and thus will increase with larger operation size. Greater labor efficiency will ultimately lower the cost of production on a pasture-based dairy.

Calving window

The calving window indicator represents the percentage of calves born in the window, or time period. In Missouri, some of the most profitable grazing dairies are seasonal producers. These operations intend to calve in the spring and are able to use farm-produced grass to produce as much milk as profitable. A goal for Missouri producers is to have 80 percent calved in an eight-week window beginning the middle of February and the remaining calves born within a 12-week window.

Financial KPIs

A business must be profitable to survive. Financial KPIs measure profitability or cost goals. Unpaid operator or family labor should be factored into these calculations. The key to calculating these indicators is to keep detailed farm financial records and to complete a yearly income statement and balance sheet.

Net farm income from operations (NFIFO)

NFIFO is a measure of the net income generated from the ordinary production and marketing activities of the farm. It is calculated by subtracting the gross farm expenses from the gross farm revenue. NFIFO is the easiest way to see if the farm is covering the cash cost of production.

Return on assets (ROA)

ROA is an indication of profitability per dollar of asset. This measure is a good indicator of how well the farm investment is doing compared with other investment opportunities. It is calculated by taking NFIFO, adding interest paid, subtracting the value of unpaid family labor, and then dividing this total by the value of farm assets calculated at the beginning of the financial year. Many pasture-based dairy farms have routinely maintained a range of 8 to 15 percent ROA, but a minimum return goal should at least be greater than the interest rate paid on the debt.

Table 11. Example of a pasture-based dairy farm's key performance indicators.

	When to measure					
	Daily	Weekly	Quarterly	Annually	How to measure	Benchmarks for comparison
Physical KPIs						
Average cover		■			Grazing wedge calculations	Seasonal plan
Pre-grazing cover	■				Plate meter next paddock to graze	Management goal
Post-grazing cover	■				Plate meter last paddock grazed	Management goal
Milk per acre			■	■	Add milk shipments and divide by useable acres	Historical and peer group
Milk per cow	■	■	■	■	Add milk shipments and divide by milking cows	Historical and peer group
Tons dry matter per acre		■		■	Grazing wedge summaries	Historical and peer group
Financial KPIs						
Cost to produce cwt milk			■	■	Financial record analysis	Peer groups or published benchmarks
Operating expense ratio				■	Financial record analysis	Peer groups or farm financial standards council
Interest expense ratio				■	Financial record analysis	Peer groups or farm financial standards council
Term debt coverage ratio				■	Financial record analysis	Peer groups or farm financial standards council

Cost to produce cwt of milk

Dairy farmers need to understand the cost of producing 100 pounds of milk. The annual cost of production allows a farmer to understand the efficiency and competitive position of the operation. Monthly cost of production estimates take more work but can allow seasonal dairy producers to quickly estimate the financial impacts of different calving seasons and winter milking. See MU publication G3651, *How to Compute Your Cost of Producing Milk*, for more information on performing this analysis.

Operating expense ratio

The operating expense ratio provides an understanding of a dairy farm's cost control. To calculate the operating expense ratio, divide total operating expenses (minus depreciation) by gross revenue.

Interest expense ratio

The interest expense ratio reveals the proportion of interest expenses that are consumed out of total farm revenue. To calculate the interest expense ratio, divide the total farm interest expense by gross revenue.

Term debt coverage ratio

Term debt coverage ratio represents the net income available from the business annually for every dollar of principal and interest payments on term debt. It is used to understand the farm's ability to repay term debt on time. Figure 2 shows how to calculate the term debt coverage ratio. A ratio of 1.5 or greater is generally accepted as a strong liquidity position.

$$\textbf{Term debt coverage ratio} = \frac{\text{Net farm income + Nonfarm income + Depreciation + Term and lease interest – Family living expenses – Income taxes}}{\text{Scheduled principal and interest payments on term loans and leases}}$$

Figure 2. Calculating term debt coverage ratio.

This publication replaces Chapter 14, Economics of a Pasture-Based Dairy, in MU Extension publication M168, *Dairy Grazing Manual*. Original authors: Stacey A. Hamilton, Greg J. Bishop-Hurley and Ron Young, University of Missouri.