doi:10.2489/jswc.2024.0122A

IDEAS & INNOVATIONS

Low-overhead dairy grazing: A specific solution to a vexing problem

Jonathan R. Winsten

US DAIRY: CASHFLOW TRUMPS PROFITABILITY

The dairy sector has been the backbone of many rural communities across the traditional US Dairy Belt (i.e., the states from Maine to Minnesota) since the early twentieth century. The dramatic loss of dairy farms throughout the region over the past 30 years has contributed to an unraveling of the fabric of its rural communities (Spratt et al. 2021). An important driver of this trend has been extreme volatility and a downward trend in real (i.e., inflation-adjusted) farmgate milk prices. In response, many remaining dairy farms have greatly increased herd size and milk production per cow; "get big or get out" has been the clear writing on the proverbial wall. Farmers who have followed this path have generally demonstrated an impressive application of science, technology, and management to consistently produce an average of over 25,000 lb of milk per cow per year in herds with hundreds or thousands of cows.

Unfortunately, there are a host of vexing issues associated with the increasing trend toward large modern confinement-feeding dairy farms. These farms are very capital-intensive and the resulting level of assets (and debt) per cow necessitates maximum milk production per cow (Winsten et al. 2000, 2010). Very high grain-to-forage feeding ratios can increase the incidence of metabolic disorders, resulting in increased use of antibiotics and increased culling rates. The very high capital requirements preclude most farm workers from becoming farm owners. The use of heavy equipment and manure-handling systems is associated with higher rates of worker injuries and fatalities (Douphrate et al. 2013). From an environmental perspective, large modern dairy farms often import much more nutrients (e.g., grain and fertilizer) onto the farm than the farm's land base can assimilate (Kellogg 2000). The more extreme the nutrient imbalance, the greater the risk for nutrient loss to ground and surface water. Greenhouse gas emissions per acre of land can be relatively high under this system, although it can be relatively low per unit of milk production (Chiianese et al. 2009).

The financial structure of traditional or large modern confinement-feeding dairy farms results in cashflow concerns often becoming paramount over profitability. The path to positive cashflow for most dairy farms is more cows and maximum milk production per cow. However, in the long-term, no business can survive if its revenue does not exceed its total economic costs, regardless of cashflow.

A basic tenet of economics states that when the price paid for a product goes up, producers will respond by producing more of that product; conversely, when prices go down, they will produce less by switching to produce another product. On the surface, the dairy sector seems to defy this law of economics with farmers choosing to add more cows (when possible) when prices go down, as well as when prices go up. A closer look reveals that this is a result of high levels of capital tied up in a system that is only designed to produce one product—milk. This unusual response to market price signals is likely to be contributing to the oversupply that results in increasingly volatile and downward trend in milk prices. Finding a way out of this vicious cycle is crucial for the future of dairy farming throughout the Dairy Belt states.

The benefits of dairy grazing for herd health, the environment, and reducing direct costs (e.g., feed, fuel, and fertilizer) per hundred-weight (cwt) of milk have been known for a long time (Winsten et al. 2000, 2010; Franzluebbers et al. 2012). The problem with dairy grazing has been that lower milk production per cow and operations with limited animal housing (hence, limited herd size) may be producing and selling too few cwts of milk to cover full economic costs of production. The organic and grass-fed markets have helped increase revenues for many dairy grazing farms. Dairy grazing operations that can efficiently manage larger herds using limited buildings and machinery seem to have a higher probability of success in the long-term, whether producing organic or conventional milk.

LOW-OVERHEAD DAIRY GRAZING: AN OVERVIEW

Low-overhead dairy grazing has a different financial structure that allows it to avoid many of the problems faced by traditional and large modern dairy farms. The low-overhead dairy grazing system described here is an adaptation of the New Zealand dairy grazing system, but modified to work across the US Dairy Belt. This system is characterized by (1) maximum nutrient intake from grazed pasture, (2) a high-throughput milking system that can efficiently accommodate a herd of at least 200 to 300 cows, and (3) the minimum necessary investment in buildings and machinery. Farms with this system should be able to greatly reduce both variable and fixed (overhead) costs of production and be profitable over a much wider set of milk and feed prices than traditional or large modern confinement dairy farms (Winsten et al. 2010).

Feed costs, which include the costs of producing and purchasing feed, are almost always the single largest operating expense on any US dairy farm (Winsten et al. 2010), which makes feed efficiency (i.e., minimizing feed costs per unit of milk produced) exceptionally important. Dairy grazing focuses on maximizing the herd's nutrient intake from grazed pasture, which is one of the lowest cost sources of nutrient intake. Supplemental grain feeding will boost milk production and profits in most cases (although "grass-fed" dairy farms receive a price premium for not feeding grain). The grazing season in the Dairy Belt is generally from May through

Jonathan R. Winsten is a senior agricultural economist, Winrock International, Shelburne, Vermont.

Received January 22, 2024.

October and can be extended by stockpiling standing forage for later grazing. Harvested and stored forages will be required for feeding in the nongrazing months, but the amount (and cost) is significantly less than feeding stored forages year-round.

Labor is often a very constraining resource on dairy farms and is a major expense (Winsten et al. 2010). Labor efficiency can be gauged by milk sold per full-time equivalent (FTE) worker, and large modern dairy farms aim to sell at least 1.2 million pounds of milk per FTE. Grazing operations generally produce significantly less milk per cow than confinement-feeding operations and, therefore, need a large herd size and efficient feeding and milking system to be able to ship more than 1 million pounds per FTE worker. There are several ways in which grazing operations can be labor efficient. First, having cows graze for much of their feed and spread much of their manure at the same time is an important labor savings and improves farm safety (Douphrate et al. 2013). Second, many low-overhead dairy grazing operations use a seasonal calving schedule to concentrate time-consuming activities, such as calving, calf-rearing (figure 1), weaning, and breeding, into discrete windows of time. Third, and very importantly, the use of high-throughput milking parlors (figure 2) allow a larger herd to be milked relatively quickly (i.e., up to 100 cows per hour per person).

As discussed above, the capital requirements of most dairy farms create high fixed costs of production. By minimizing the cost of cow housing and machinery for fieldwork and farm operations, the low-overhead dairy grazing operation has the potential to greatly reduce its fixed and total costs of production per cwt of milk produced. Lower costs will not only allow a farm to be profitable at lower milk prices, it also can reduce the likelihood that cash-flow concerns overshadow decision-making about profitability, which can result in the perverse outcome of farms producing more milk when milk prices are lower. As economic theory would dictate, a farm with fewer assets tied up in dairy-specific infrastructure and equipment could more easily pivot toward beef production when milk prices become too low.

Figure 1
Efficient calf feeding is essential for larger seasonal calving herds. This trailer unit is foldable for transportation.

Figure 2
High-throughput swing milking parlors allow quicker milking.

SCENARIO DEVELOPMENT FOR ANALYSIS

An expert panel of farmers using low-overhead dairy grazing and dairy farm financial experts was recently used to create hypothetical farm financial statements that represent the use of this system in the Great Lakes region. There are many different ways that such a farm can be structured and operated. Numerous assumptions were made to develop specific financial statements for the farm.

To avoid variables such as the farmers' level of equity in the farm real estate and local property tax rates, the analysis assumed the farmer had a 15-year lease on a 360 ac farm with typical buildings suitable for a 120-cow confined herd. There are many such farms in the Dairy Belt that are no longer in operation and could be available to rent. The rental rate used (US$78,000 yr^{-1}) can be considered a proxy value reflective of the costs of ownership including property taxes. The analysis used conservative assumptions and was designed to be representative of what a farmer with experience could expect to achieve.

The farmer borrows money to retrofit a 20-unit swing milking parlor with milkhouse, holding area, and a 250 ft double-sided feed bunk with concrete pad, and a covered bedded pack for emergency housing. Although it is unusual to invest in improvements on a rented farm, the internal rate of return over 15 years shows this to be a very good investment. The farmer establishes pastures and a grazing system (i.e., fences, lanes, and water) on the land and milks a herd of 240 medium-framed cows on the farm with spring calving (all cows dry in January and February). The average milk production is 15,000 lb cow^{-1} yr^{-1}. The cows and youngstock are outwintered on the farm; cold and snow are not a problem for the cows, but mud can be a serious challenge. Figure 3a shows the use of round bales as a windbreak on a small knoll. Figure 3b shows round bale feeding on the pasture in mid-winter.

Figure 3

Outwintering dairy cows can reduce overhead costs. (a) Using round bales as a wind-break; (b) feeding round bales on the pasture during mid-winter.

(a)

(b)

FINANCIAL PERFORMANCE

Income statements for Years 1 through 5 for this hypothetical low-overhead dairy grazing operation were calculated to capture the learning curve for the farmer and the cows in this new system. The results described below represent the financial performance in Year 5 after the farmer has worked most of the kinks out of the production system. The income statements include all revenues and expenses for the farm, including depreciation (annualized replacement cost of buildings and equipment) and a US$55,000 annual salary paid to the farmer (most dairy farm financial analyses do not include the cost of owner/operator labor in the calculation of net farm income).

Using historical milk and grain price data for the region, a Monte Carlo simulation with 10,000 iterations was run on the Year 5 income statement, with each iteration pulling milk and feed (grain) prices randomly from the historical price distribution. The correlation between milk and grain prices was calculated from the historical data and the correlation coefficient (0.56) was programmed into the Monte Carlo simulation. The milk:feed price ratio fluctuates over time and is extremely impactful on dairy farm profitability. The USDA Agricultural Marketing Service calculates the milk:feed price ratio on a monthly basis (USDA AMS 2024). The ratio varied from 1.3 to 2.85 during the 2011 to 2021 period, with higher numbers being more profitable for dairy farms. The 10,000 iterations of this Monte Carlo simulation had an average milk:feed price ration of 1.51, which is near the low end of the range and thus is not likely to overestimate the profitability of this scenario.

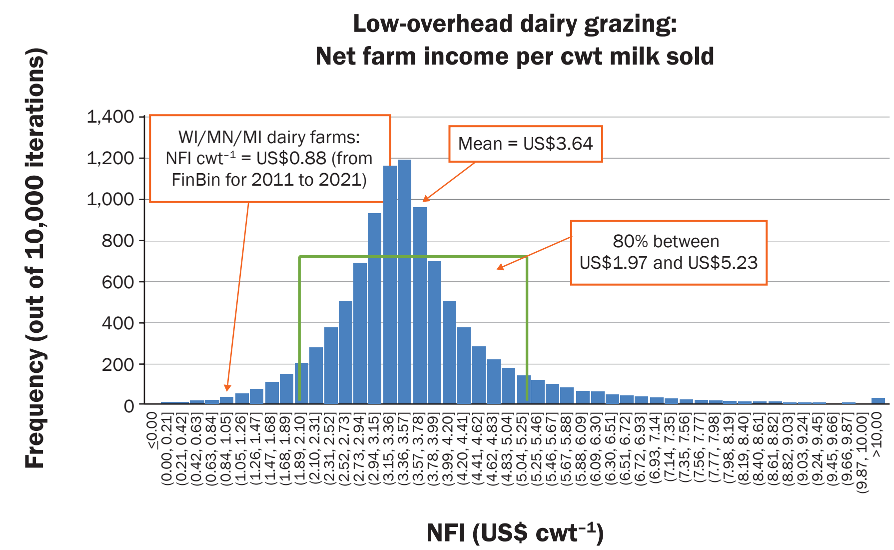
As can be seen in figure 4, the average net farm income (NFI) per hundred-weight (cwt) of milk produced was US$3.64 across the 10,000 iterations of the Monte Carlo simulation. To put this result in context, the average NFI cwt^{-1} from completed dairy farm financial analyses from FinBin (one of the largest sources of farm financial benchmark information in the world) for farms in Michigan, Wisconsin, and Minnesota during 2011 to 2021 was US$0.88, making this low-overhead dairy grazing scenario four times more profitable per unit of milk. An even more impressive result was that, of the 10,000 iterations, none resulted in a negative NFI, which indicates the ability of this production system to withstand the treacherous economic pressures felt by the region's dairy farmers, especially in recent years.

ENVIRONMENTAL AND PRO-SOCIAL IMPACTS

In addition to the private benefits of improved productivity and profitability, low-overhead dairy grazing is also likely to provide several public benefits to the

Figure 4

Distribution of net farm income (NFI) per hundred-weight (cwt) results from Monte Carlo simulation.



environment and rural communities. Productive permanent pasture holds soil and nutrients in place better than cropland (Rotz et al. 2009), and the pasture sward gets denser over time with proper grazing management. Using USDA's Integrated Farm Systems Model (IFSM), a simulation was performed showing that this 360 ac dairy grazing operation would reduce nitrogen (N) and phosphorus (P) loss by 62% and 71%, respectively, relative to a more typical 120-cow dairy farm on the identical footprint. IFSM calculated a 5% reduction in the carbon (C) footprint of milk from the low-overhead dairy grazing operation. Further, permanent vegetative cover will have superior results for wildlife (birds, bees, and other insects) relative to typical dairy crop rotations (Goosey et al. 2019; Lwiwski et al. 2015).

Previous research also suggests benefits from grazing for animal health and food safety. Grazing cows tend to have less incidence of health problems, including mastitis (Goldberg et al. 1992) and lameness (Haskell et al. 2006). Healthier cows require less frequent antibiotic treatment, which should reduce the risk of antibiotic residue in milk and dairy products, as well as the problems associated with antibiotic resistance. The average culling rate in the US dairy sector is 30% to 40%. At a 40% culling rate, the average cow spends only 2.5 years in the milking herd before being sold for dairy beef. Grazing herds, with lower milk production per cow, often have culling rates of 12% to 20%. At 20%, the average cow spends 5 years in the milking herd; healthier cows with longer lives are an important animal welfare issue.

Healthy rural communities depend on profitable, resilient, and ecologically sustainable farm businesses for numerous reasons, including generating local economic activity and employment and protecting natural resources (Peters 2002). As described above, low-overhead dairy grazing has the potential for much greater farm profitability than traditional or more common dairy farms in the region. This system is shown to be profitable even at low milk prices. In addition to safer working conditions, the lower required investment makes it easier for new or disadvantaged farmers to enter into dairy farm ownership. This system also makes it easier for farmers to successfully pivot production away from dairy if needed while keeping land in permanent pasture. Low-overhead dairy grazing will generally be smaller operations than the increasingly common large, modern, confinement-feeding dairy farms. Hence, the successful adoption of low-overhead dairy grazing in a community will increase the number of farm businesses, each having a multiplier effect on the rural economy.

In any given watershed, a higher percentage of land in well-managed pasture is likely to reduce nutrient and sediment losses to surface water due to more permanent vegetative cover, thereby improving water quality in streams, rivers, and lakes (Park et al. 2017). Improved water quality benefits fish and other aquatic species, as well as people who utilize the water resources for recreation or consumption. Lastly, more land in grazing can enhance rural economies from increased tourism revenue (Gao et al. 2014).

MAKING CHANGE WHILE THE CLOCK TICKS

There are numerous potential benefits for farmers, residents, communities, and ecosystems of region-wide adoption of low-overhead dairy grazing. The open question remains: can the adoption of this very different dairy production system happen fast enough and wide enough to confer its benefits before too many farms are lost and too much land is concentrated under the control of increasingly large confinement-feeding dairy operations?

A recent article by Spratt et al. (2021) made numerous recommendations for how to accelerate grazing adoption. The farm financial results of low-overhead dairy grazing described above indicate that a strong profit-motive exists for farmers to adopt this system. The challenge is to get enough working examples of this system across the landscape so that every dairy farmer can understand how it works and see its success.

Improving water quality and mitigating climate change depends on much more perennial vegetative cover in the Great Lakes Basin and beyond. Profitable examples of farming with perennial vegetative cover are not plentiful and are not as obvious to farmers as they need to be. Low-overhead dairy grazing may be a shining star rising on the horizon.

ACKNOWLEDGEMENTS

This article and the analyses described in it were made possible with support from Grassland 2.0 and the Great Lakes Protection Fund to the Wallace Center at Winrock International.

REFERENCES

Chiianese, D.S., C.A. Rotz, and T.L. Richard. 2009. Simulation of methane emissions from dairy farms to assess greenhouse gas reduction strategies. Transactions of the ASABE 52(4):1313-1323.

Douphrate, D.I., L. Stallones, C. Lunner Kolstrup, et al. 2013. Work-related injuries and fatalities on dairy farm operations-a global perspective. Journal of Agromedicine 18(3):256–264. doi:10.1080/1059924X.2013.796904.

Gao, J., C. Barbieri, and C. Valdivia. 2014. Agricultural landscape preferences: Implications for agritour¬ism development. Journal of Travel Research 53(3):366-379.

Goldberg, J.J., E.E. Wildman, J.W. Pankey, J.R. Kunkel, D.B. Howard, and B.M. Murphy. 1992. The influ¬ence of intensively managed rotational grazing, traditional continuous grazing, and confinement housing on bulk tank milk quality and udder health. Journal of Dairy Science 75(1):96-104.

Goosey, H.B., J.T. Smith, K.M. O'Neill, and D.E. Naugle. 2019. Ground-dwelling arthropod com¬munity response to livestock grazing: Implications for avian conservation. Environmental Entomology 48(4):856-866.

Kellogg, R.L. 2000. Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients: Spatial and Temporal Trends for the United States. Washington, DC: USDA Natural Resources Conservation Service.

Lwiwski, T.C., N. Koper, and D.C. Henderson. 2015. Stocking rates and vegetation structure, heterogeneity, and community in a northern mixed-grass prairie. Rangeland Ecology & Management 68(4):322-331.

Park, J.Y., S. Ale, W.R. Teague, and S.L. Dowhower. 2017. Simulating hydrologic responses to alternate grazing management practices at the ranch and watershed scales. Journal of Soil and Water Conservation 72(2):102-121. https://doi.org/10.2489/jswc.72.2.102.

Peters, D. 2002. Revisiting the Goldschmidt Hypothesis: The Effect of Economic Structure on Socioeconomic Conditions in the Rural Midwest. Jefferson City, MO: MERIC, Missouri Department of Economic Development.

Rotz, C.A., K.J. Soder, R.H. Skinner, C.J. Dell, P.J. Kleinman, J.P. Schmidt, and R.B. Bryant. 2009. Grazing can reduce the environmental impact of dairy production systems. Forage and Grazinglands 7(1):1-9.

Spratt, E., J. Jordan, J. Winsten, P. Huff, C. van Schaik, J. Grimsbo Jewett, M. Filbert, J. Luhman, E. Meier, and L. Paine 2021. Accelerating regenerative grazing to tackle farm, environmental, and societal challenges in the upper Midwest. Journal of Soil and Water Conservation 76(1):15A-23A.

USDA AMS (Agricultural Marketing Service). 2024. Dairy Market News. Page G1. Volume 91, Report 1. Washington, DC: USDA AMS. https://downloads.usda.library.cornell.edu/usda-esmis/files/z603qx43s/73667q594/6d571k384/DYWWEEKLYREPORT.PDF.

Winsten, J.R., C.D. Kerchner, A. Richardson, A. Lichau, and J.M. Hyman. 2010. Trends in the northeast dairy industry: Large-scale modern confinement feeding and management-intensive grazing. Journal of Dairy Science 93:1759-1769.

Winsten, J.R., R.L. Parsons, and G.D. Hanson. 2000. The profitability of management-intensive grazing for northeastern dairy farms. Agricultural and Resource Economics Review 29(2):1-9.