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Economic Efficiency in Organic Dairy Operations

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Organic dairy operations have historically commanded a higher milk price than conventional dairy operations (Organic all milk price 2021 average: $31.55 per hundredweight (USDA AMS, 2021), Conventional all milk price 2021 average: $20.25 per hundredweight (USDA ERS, 2021)). However, the economics of decision-making and management still play a pivotal role in farm profitability. As part of a grant funded by USDA NIFA OREI (2015-51300-24140), researchers at the University of Kentucky and the University of Tennessee explored the impact of various changes on the farm and their economic impact through a comprehensive model. The model was created based on information collected from organic dairies in Kentucky and Tennessee. All the numbers discussed will be based on a model 50-cow herd and a 300-day lactation. This publication will outline the impacts of changes both those within and outside of the farm's control.

Milk Production

Four levels of milk production were considered: 40, 45, 50 and 55 lbs./cow/day. The ability of pasture to provide nutrition was held constant across all models with supplemental silage, and corn grain to support greater levels of milk production. As production increased, net returns for the farm (total revenue – total costs) increased. For example, increasing milk production from 40 to 45 lbs./cow/day increased net farm revenue by 42 percent and only increased feed costs by 6 percent (roughly an additional 0.5 lbs. corn silage and 0.6 lbs. shelled corn per cow per day). The same was true for increasing from 45 to 50 lbs./cow/day. Net revenue increased by 29 percent however feed cost only increased by 7 percent. Net return was smaller if a farm increased production from 50 to 55 lbs./cow/day because feed cost increased by 13 percent to support the increased milk production. In total, if a farm was able to increase from 40 lbs./cow/day up to 55 lbs./cow/day, farm net revenue increased by 109 percent, even with the additional costs of shelled corn (75 percent increase in cost) and corn silage (6 percent increase in cost).

Main Takeaway: Organic producers should consider the additional investment in feed supplementation to increase production returns. Even a 5 lbs. increase in average milk production increased net return by almost 50 percent, as most non-feed costs are unaffected by targeting higher production levels.

Cautions: Current market price for milk ($/cwt) and corn ($/bushel) should be considered. For example, if corn prices rise substantially, feed costs make up a greater percentage of total costs and decrease net return. If milk price falls, increased milk production would not show the same increase in net revenue.

Pasture Mixture

Standard annual, standard perennial, modified annual with potential for reseeding, and producer-recommended annual forage mixtures were identified by forage specialists at the University of Tennessee and the University of Kentucky and participating organic producers. Of the four pasture mixtures evaluated (Table 1), the standard perennial forage mixture was determined to be the most economically feasible. The standard perennial mixture had the lowest cost because all species were perennials, requiring the least seed and machinery costs over a 4-year period. If the pasture was used beyond four years, which is a likely need for most dairy operations, additional seed and machinery costs would be added after year four. The other mixtures evaluated could require up to two seedings per year, increasing the costs associated with establishing and maintaining pastures. In additional studies by a student at the University of Tennessee (Bailey, 2019), the standard perennial mixture also provided the highest forage quality of the four mixtures (see SP802 for more information; Table 2). various ailments.

Table 1. Mixtures evaluated during Southern organic medium-sized-plot trials (Allison et al., 2021).

Mixture Name	Species	Classification	Life Cycle
Standard Annual	Annual ryegrass	Cool season grass	Annual
	Crimson clover	Cool season legume	Annual
	Sorghum-sudangrass	Warm season grass	Annual
	Cowpea	Warm season legume	Annual
Standard Perennial	Alfalfa	Cool season legume	Perennial
	Red clover	Cool season legume	Perennial
	Orchardgrass	Cool season grass	Perennial
	Tall fescue	Cool season grass	Perennial
Modified Annual[1]	Annual ryegrass	Cool season grass	Annual
	Red clover	Cool season legume	Perennial
	Crabgrass	Warm season grass	Annual
	Annual lespedeza	Warm season legume	Annual
PR Annual[2]	Forage turnip	Cool season brassica	Annual
	Forage rape	Cool season brassica	Annual
	Spring oats	Cool season grass	Annual
	Annual ryegrass	Cool season grass	Annual
	Sorghum-sudangrass	Warm season grass	Annual
	Cowpea	Warm season grass	Annual

[1] *The Modified Annual forage mixture included species with potential for reseeding (crabgrass and annual lespedeza). Reseeding could decrease additional costs for seeding and machine costs.*

[2] *The PR Annual forage mixture was a mixture of species commonly used by the cooperating dairy producers.*

Table 2. Nutrient content of four mixtures evaluated during Southern organic medium-sized plot trials (unpublished).

Miture Name	Season	Crude Protein	Acid Detergent Fiber (%)	Neutral Detergent Fiber (NDF; %)	48-hr NDF[1] (%)
Standard Annual	Spring	16.0	31.1	49.9	77.7
	Summer	16.1	33.6	57.0	73.0
	Average	16.0	32.4	53.4	75.3
Standard Perennial	Spring	16.4	30.9	50.1	77.2
	Summer	17.7	33.3	53.2	71.3
	Average	17.1	32.1	51.6	74.2
Modified Annual[2]	Spring	17.6	31.4	52.9	74.6
	Summer	18.5	32.9	56.1	69.0
	Average	18.0	32.2	54.5	71.8
PR Annual[3]	Spring	15.0	30.5	49.9	77.9
	Summer	15.8	33.3	56.1	74.0
	Average	15.4	31.9	53.3	76.0

[1] *In vitro Neutral Detergent Fiber digestibility of feed at 48 hours after incubation.*

[2] *The Modified Annual forage mixture included species with potential for reseeding (crabgrass and annual lespedeza). Reseeding could decrease additional costs for seeding and machine costs.*

[3] *The PR Annual forage mixture was a mixture of species commonly used by the cooperating dairy producers.*

A stocking rate of approximately 1 acre per cow (model assumed 1,300 lbs. cows) was assumed on all pastures. Model results suggested that pasture provided at most 98 percent of the cow's dry matter intake, and at minimum 91 percent of the cow's dry matter intake when production was highest. Although pasture was a vital part of a dairy cow's diet, it was not enough to meet the nutritional demands of milk production even at the lowest production level (40 lbs./cow/day). Additional dietary energy was provided by corn silage and shelled corn.

Main Takeaway: The standard perennial forage mixture of alfalfa, red clover, orchardgrass and tall fescue was the most economically feasible mixture identified. This mixture also showed a moderate increase in nutrient quality over the annual forage mixtures. However, all pasture mixtures would require some supplementation regardless of milk production level.

Cautions: As more corn silage is needed, pasture ground may need to be converted to silage production. If hay production is a supplemental income source, farm revenue may be decreased. However, increased milk production revenues outweighed additional feed costs and any lost hay revenues in all model scenarios.

Milk Price

Break-even price refers to the value when total revenue is equal to total cost. For example, a product is sold for $100 but it costs $100 to produce it. In terms of a break-even milk price, the milk sold would breakeven when price received covers all costs associated with production of the milk sold. Theoretically, any value over the break-even price would be a net profit. In the model, a break-even price was calculated for the four milk production levels considered (Table 3). As production increases, the costs of production also increased due to increased expenses for shelled corn and corn silage. However, net farm revenue increased by 109 percent as production increased from 40 to 55 lbs./cow/day, even with the higher costs for supplemental feed. Although the break-even milk price increased, it was more than offset by the value of the additional pounds of milk produced. Similarly, the break-even analyses indicated that milk prices could fall 20 to 35 percent from 2018 levels and still cover the costs of organic production (Allison et al, 2021).

Table 3. Break-even milk price ($/cwt) based on model assumptions and changes in milk production. Comparisons can be made against the 2018 average milk price (Allison et al., 2021).

Production Level	Break-Even Milk Price ($/cwt)
40 lbs./cow/day	$19.56
45 lbs./cow/day	$20.23
50 lbs./cow/day	$21.87
55 lbs./cow/day	$24.00
2018 Organic Market Milk Price	$30.00

Main Takeaway: Lower production and the lower inputs modeled with it (heavy reliance on pasture, limited additional feed) corresponded to a lower break-even milk price. Meaning, milk prices could fall up to 35 percent from the 2018 Organic Market Milk Price and still cover costs of production. Greater milk production (higher input costs of shelled corn and silage) corresponded to a greater break-even milk price. Changes in milk prices could impact optimal productivity levels.

Cautions: Although a lower production level corresponded to a lower break-even milk price, this does not mean it was the most profitable scenario. This break-even price should only be considered as a guideline. Individual farm costs will vary, as will the market milk price. If you are interested in calculating your specific farm costs, reach out to your local MANAGE agent or visit the Dairy Gauge page for more information.

Impact of Transitioning to Organic

A long period of financial uncertainty occurs during the transition from conventional to organic dairying. Three years is needed to transition the land and herd from conventional to organic standards (eCFR Title 7: Part 205). To account for this period, the model attempted to calculate the cost of the transition. During years one and two, the pasture and feed were produced organically but purchased grain was non-organic. In year three, pastures, feed and purchased grain were all organic. However, organic milk prices were not received until year four. Using the assumptions of a low milk production level (40 lbs./cow/day), a net present value (NPV) and internal rate of return (IRR) were calculated over different investment periods (10 to 25 years in operation) and with a discount rate from 3 to 9 percent. Net present value is a way to value a stream of future cash flows (i.e., farm income) using a discount rate. The discount rate can be thought of as the return rate that is required to justify the investment. If a producer wanted a 5 percent rate of return, and the actual rate of return was 5 percent, the NPV would be zero. A positive NPV would result if the rate of return exceeded 5 percent and a negative NPV would result if the rate of return were less than 5 percent.

Essentially, the model is trying to determine if investing a certain amount of money today will earn at least its value (NPV = $0) *tomorrow.* In this case, *tomorrow* would be 10 to 25 years in the future. The internal rate of return calculates the compounded (year + year + year) return on an initial investment. In other words, it gives us an idea of the potential percentage return on an investment over time (life of operation). The internal rate of return can be compared to other investments while at the same time considering risk levels. Due to risk, the required rate of return on an organic dairy farm should be higher than a risk-free investment like a certificate of deposit.

The model analyzed the impact of different expected lengths of business operation on the decision to transition to organic production. The longer a business could operate (life of operation) the better the NPV and IRR (Table 4). For instance, if the dairy was only in operation for 10 years after the initial investment (Year 1), there would only be seven years for the dairy to receive payments as an organic operation (10 years total life – 3 years of transition = 7 years organic). This resulted in a negative NPV and IRR, regardless of the discount rate considered. A similar situation was seen if a dairy was in operation for 15 years after the initial investment. The results from the model suggested that a dairy must remain in operation for at least 20 years for the cost of transitioning to be a worthwhile investment. However, this study did not model potential higher sale prices of the operation following the transition. It is possible that operating the dairy for a shorter time and selling the operation for a higher profit could still be beneficial

Table 4. Net Present Value (NPV) and Internal Rate of Return (IRR) by Life of Operation (years; Allison et al., 2021).

	Life of Operation			
Discount Rate	**10 Years**	**15 Years**	**20 Years**	**25 Years**
3%	($67,705)	$1,292	$60,809	$112,149
5%	($74,857)	($21,042)	$21, 124	$54,162
7%	($80,347)	($38.146)	($8,057)	$13,397
9%	($84,496)	($51.229)	($29,608)	($15,556)
	IRR Given Life of Operation			
N/A	(6.1%)	3.1%	6.4%	7.8%

Main Takeaway: The financial risk associated with transitioning to an organic operation is substantial, particularly if a dairy does not plan to remain in operation longer than 15 years after initiating the transition. However, the potential returns to an operation can make the transition worthwhile.

Cautions: These results are based on model simulations with certain constraints. This includes the lowest level of milk production and does not consider the sale of the operation as a potential revenue generator. The outcomes of this model will change, depending on the current market conditions and the price of organic and conventional milk per hundredweight. Additionally, entry into the organic market depends on the demand of organic milk companies looking for new producers. Without additional market demand, producers will not have a higher price for their milk.

Summary

The 2018 Organic Market Milk Price allowed for increased expenses from purchased feeds (grain corn and silage) to maximize milk production in the model. Increasing production by 10 lbs./cow/day (45 to 55 lbs./cow/day) resulted in a net revenue increase of 109 percent. This was maximized when the forage mixture was a combination of alfalfa, red clover, orchardgrass and tall fescue. Primarily because the persistence of the forages used in the mixture reduced seeding and maintenance costs. Although organic milk marketing corresponded to a higher price than conventional, transitioning a dairy to organic from conventional should not be attempted unless the operation plans to remain in business for a least 15 years after initiating the transition. Entry into the organic milk market also depends on market demand and organic milk companies looking for new producers.

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