

2
TA 265.6
B183de
14:1



Texas Agricultural Extension Service
The Texas A&M University System

Balanced Dairying ECONOMICS

Vol. 14, No. 1

Robert B. Schwart, Jr.
Robert B. Schwart, Jr.
Extension Economist-Dairy Marketing
Department of Agricultural Economics
College Station, TX 77843-2124
(409) 845-5284

Government Publications
Texas State Documents
January 31, 1994
APR 12 1994
Depository
Dallas Public Library

INVESTMENTS IN FREE STALL DAIRY HOUSING: ESTIMATED COSTS, RETURNS AND RISK

by Amy Pagano, John Holt, Robert Schwart, William Boggess and Michael DeLorenzo¹

Free stall dairying has been commonplace for over 20 years in the Midwest, the Pacific Northwest, and Europe. A growing number of large dairy herd managers in the South are considering free stall dairying. Some dairy producers are interested in free stall facilities because of perceived environmental compliance benefits. Others believe that revenues from increased milk production plus savings from increased management efficiencies from free stall dairying will offset the investment cost. Any investment entails risk, however. For dairy producers, investment feasibility is affected by such risks as the possibility of abrupt increases in costs, drops in milk price or drops in livestock prices.

Implications of Risk for the Feasibility of an Investment in Free Stall Housing

Estimates based on an analysis of data developed for a representative dairy in central Texas show that the expected returns from investing in a free stall facility are likely to exceed the cost 57 percent of the time. That is, in 6 years out of 10, the revenues from an investment in a free stall facility will be sufficient to pay the annual cost of financing the new facility.

We developed estimates of the investment costs for constructing a free stall facility and its accompanying waste management system in central Texas for a 1,200-cow dairy (milking 1,000 cows). For this representative Texas dairy, estimated costs and returns from free stall dairying were compared with costs and returns from continued dairying on an open lot facility. These comparisons were made with and without consideration of risk. The

¹ Assistant Research Scientist, TAMU; Prof. & Ext. Economist, U. of Fla.; Prof. & Ext. Economist, TAMU; Prof., U. of Fla.; Assoc. Prof., U. of Fla., respectively.

without-risk analysis makes investing in a free stall facility appear attractive. However, considering the risk associated with free stall dairying, some may want to reconsider. We discuss the implications of this economic analysis for investment decision making.

Estimated Investment Costs for a Free Stall Facility

The representative dairy used for this analysis is currently operating a conventional 1,200-cow open lot dairy on 400 acres. The environmental-compliance reason for considering free stall dairying is to reduce the land susceptible to runoff. Free stall housing is constructed for the milking herd only (1,000 cows). Open lot dairies in central Texas irrigate approximately 6 acres per 100 cows in conjunction with the waste management system. Additional irrigated acreage is required for a free stall facility; a good rule of thumb is 50 acres per 100 cows (Armstrong). More irrigated acreage is needed because the recycled waste water from free stall flush systems contains more nitrogen and phosphorous. Investment cost estimates for adding a free stall facility are summarized in Table 1.

In the investment profile in Table 1, the only variant in dairy facilities is a free stall barn and a new waste management system. The waste management system in conjunction with the free stall barn is built from scratch, rather than retro-fitting.

Comparing Profiles of Open Lot and Free Stall Dairies

Milk sales and feed costs are the major differences in costs and returns between free stall dairies and open lot dairies (Pagano *et*

al.). Average annual tank sales on a free stall dairy are 245,662 hundredweight. Average annual tank sales on an open lot dairy are 227,329 hundredweight. The central Texas milk price used in this investment analysis is \$12 per hundredweight. This estimated average milk price is 12 percent below a 36-month average (1990 to 1992) of \$13.63 per hundredweight (Texas Milk Market Report). In the investment analysis, the milk price received is unchanged whether the dairy is an open lot or a free stall facility.

Feed costs on a representative open lot dairy average \$5.28 per hundredweight of milk produced, contrasted with feed costs on a representative free stall dairy averaging \$5.19 per hundredweight of milk produced (Pagano *et al.*). Improved cow comfort enhances dairy feed efficiency. Under stressful conditions, at least 1 pound of dry matter consumption is required for each 1.1 pound of milk produced; under favorable conditions, feed requirements drop to 1 pound of dry matter consumed per 1.5 pounds of milk produced. Wasted feed in free stall barns is less than when cows are fed outdoors on open lots. Improvement in feed efficiency from moving into free stall facilities ranges between 4 and 20 percent. For this research, a 6 percent improvement in feed efficiency was used as representative.

A summary of costs and returns for a representative open lot dairy is displayed in Table 2, and a summary for a representative free stall dairy is given in Table 3.

Most revenue and expense categories (those marked with asterisks) are assumed similar for either open lot or free stall dairies. These figures are summaries; for a detailed breakdown of revenues and expenses, please see Pagano *et al.* The free stall facility costs

\$950,000, of which \$800,000 is borrowed and \$150,000 is a down payment from owner cash resources. The interest rate on the loan is 8 percent. Annual revenues required for interest and principal payments plus recouping the down payment on the free stall investment are \$110,988. Deducting investment financing costs, anticipated net returns from the free stall dairy are \$141,607. Without accounting for risk, the difference in anticipated net returns to equity and management between an open lot dairy and a free stall dairy is \$35,843. This is the anticipated annual cash flow from an investment in a free stall facility; it represents what a dairy producer would expect to earn each year from free stall dairying, over and above previous earnings from open lot dairying.

Details on Cost Differences

Several aspects of dairying are not affected by moving to a free stall facility. Animal sales and purchase patterns are represented as being similar on open lot and free stall dairies. For this representative central Texas dairy, on average 83 percent of the cows in the herd are in milk. The average calving interval is 13.6 months; the annual cull rate is 33 percent including a 3 percent death loss. The representative dairy buys springers and 5 bulls per year. Most breeding is done with artificial insemination. The dairy sells cull cows and all its calves. They buy springers rather than raising replacements.

Labor costs on representative open lot and free stall dairies are represented as being similar. Although there are differences in the allocation of tasks on the two types of facilities, for this research the size of the work forces on 1,200-cow dairies are the same. Financing and capitalization structure was the

same for this representative dairy, before and after adding free stall facilities.

An investment in a free stall dairy facility is expected to yield positive net returns, on average. The representative dairy expects to produce 8 percent more milk after converting to a free stall operation. The representative dairy saves \$18,000 per year in corral-scraping and manure-hauling costs, plus a free stall operation has no expenditures for fly control. These gains are partially offset by anticipated higher milk hauling costs (but there is no difference on a per-hundredweight basis) and by higher total feed costs (though feed costs are lower on a per-hundredweight basis). Though feed efficiency improves by 6 percent on a free stall dairy, total milk production also increases after the new facility is installed. To produce this additional milk requires a net increase in feed consumption.

The change in anticipated returns to equity, management and risk due to converting from an open lot dairy into a free stall operation is \$35,843 (Table 4). In summary, without accounting for risk, in an average year a dairy producer would expect to earn an additional \$35,843 from dairying in a free stall, over and above the anticipated returns from operating a similar-sized open lot dairy.

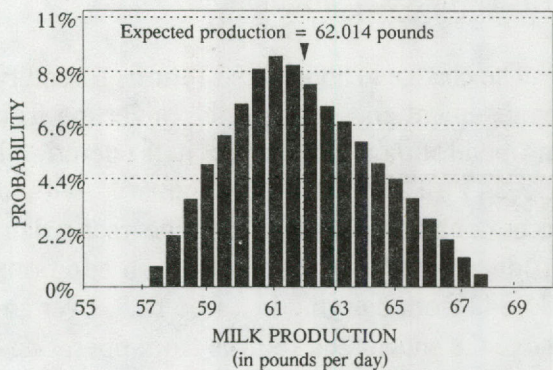
Accounting for Risk

The cost and returns estimates summarized in Table 4 depict expected dairy performance **on average**. On a day-to-day basis, however, some costs and production levels vary. This variation is due to weather (temperature and humidity), animal health, and market price fluctuations driven by economic conditions. This economic analysis shows what happens to expected returns from investing in a free stall

facility when milk production and feed costs are allowed to vary. We introduced risk by allowing per-hundredweight feed costs to go up or down by 10 percent, and by allowing milk production levels to vary a few pounds above or below the average. This was done by allowing the computer to choose a random value for feed cost and for milk production, selected from within a specified range.

For this study, the average expected daily milk production on the representative open lot dairy is 62 pounds per cow, and ranges from 57 to 68 pounds per day (Figure 1).

Figure 1: Expected Milk Production (With Risk) on a Representative Open Lot Dairy



Expected milk production on a representative free stall dairy is both higher and less variable than on a representative open lot dairy. Expected milk production on a free stall dairy ranges from 63 to 70 pounds per day (Figure 2).

For this analysis, the average cost of feed on an open lot dairy is \$5.28 per hundredweight of milk produced, plus or minus 10 percent (Figure 3).

Figure 2: Expected Milk Production (With Risk) on a Representative Free Stall Dairy

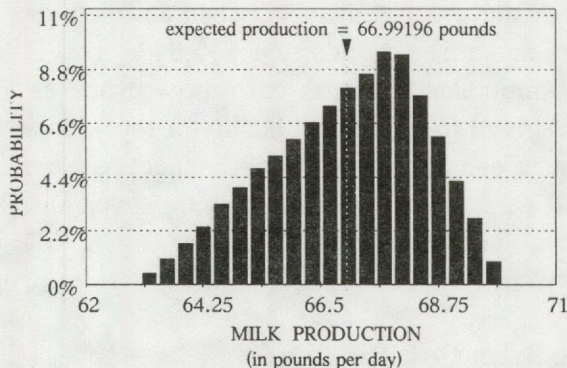
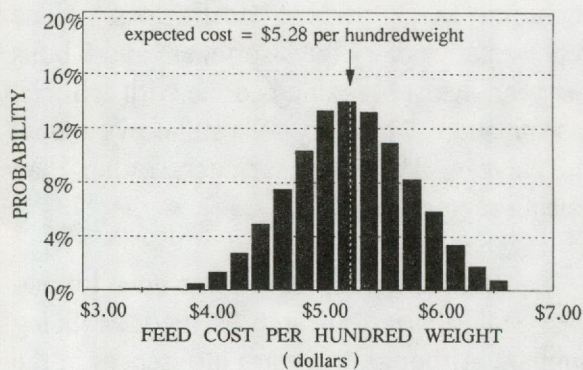
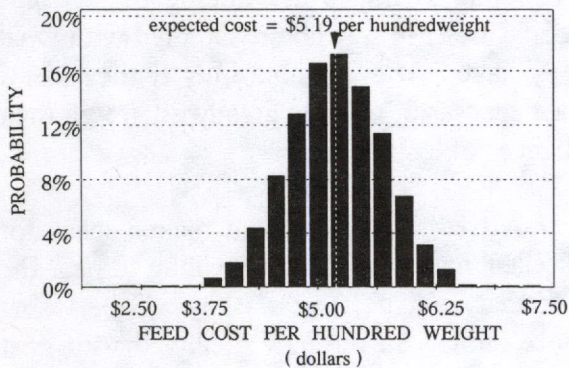


Figure 3: Expected Feed Costs (With Risk) on an Open Lot Dairy



The average cost of feed on a free stall dairy is \$5.19 per hundredweight of milk produced (Figure 4), plus or minus 10 percent. The feed costs are lower on a free stall facility than on open lot dairies, due to higher feed efficiency from improved cow comfort and less wasted feed.

Figure 4: Expected Feed Costs (With Risk) on a Free Stall Dairy



The Bottom Line

When the milk production and feed costs are allowed to vary, **average** expected returns from investing are \$35,548 (Figure 5). That is, in an **average** year, expected returns, net of financing, are \$35,548. This is approximately the same as the net returns reported in Table 4 (from the without-risk assessment); the \$295 difference between the average and the expected value is due to rounding error from the simulation.

Fifty-seven percent of the time (more than 6 years out of 10), returns from investing are sufficient to cover the annual investment cost

(\$110,899). However, 43 percent of the time (4 years out of 10) to make the payment on the free stall facility will require use of other funds. Figure 5 depicts the distribution of expected net returns when risk is introduced. The triangle's total area is 100 percent. In a given year, the odds of earning a positive net return are represented by the area of the triangle to the right of zero. The odds of sustaining a net loss in a given year are represented by the area to the left side of zero.

Figure 5: Expected Annual Net Returns from Investing in Free Stall Dairy Technology

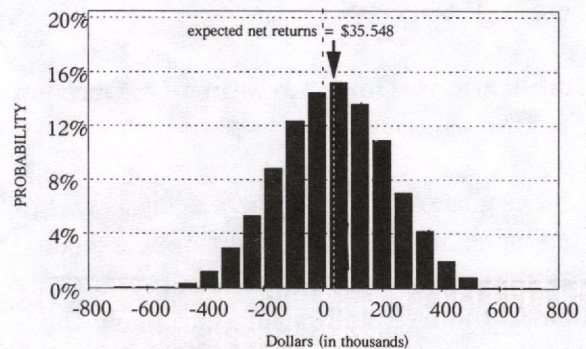


Table 5 presents another way of looking at the data presented in Figure 5. Both the data presented in Table 5 and in Figure 5 represent expected **annual** net returns from investing -- that is, expected payoffs in a given year. The expected life of a free stall facility is 15 years. Over the course of 15 years, there may well be enough good years to offset the bad years. Problems occur when the bad years happen when the facility is new and there is nothing in reserve with which to pay the banker. This

sort of bad luck can jeopardize the economic viability of a dairy operation.

A cautionary note: This set of projections about returns to free stall dairying is specific to central Texas (Erath County) and to a 1,200-cow dairy. Expected costs and returns would be different for dairies in other locations or for dairies of different sizes. Additionally, this investment analysis assumes a high level of management. Projections for managers who do not currently achieve both a rolling herd average of 19,530 pounds or above, as well as feed costs averaging \$5.28 per hundredweight, would need to make adjustment in what they could expect to achieve from a free stall facility. Their probability of economic success would be lower than the projections presented here.

Implications for Investment Decision Making

The goal of this investment analysis was to determine whether the **additional** expected earnings, resulting from gains in productivity due to the free stall facility, are likely to be enough to pay the cost of financing the investment. Though expected net returns from free stall dairying are higher than net returns

from dairying on an open lot **on average**, the odds of the investment paying for itself are 57 in 100. The chance of the investment failing to pay for itself in a given year are 43 in 100. The normal rule for deciding whether or not to invest is to invest if the returns outweigh the costs. An investment in a free stall facility pays for itself most of the time, but 43 times out of 100 the investment loses money.

Risky investments are like gambling. In Las Vegas, some gamblers go to the table frequently in hopes of winning big. Some people prefer to stay home, satisfied with what they have. They gamble only if they know their chances of winning greatly outweigh their chances of losing.

A free stall investment makes sense for excellent managers who are willing to bear the risk that in 4 of 10 years they will be losing more money on the new facility than it cost them to build it. For other people, it makes sense to think carefully before investing in a free stall facility.

Table 1: Investment Cost Estimate (Without Risk) for a 1000-Cow Free Stall Facility

ITEM	COST PER UNIT	COST PER STALL	TOTAL
Site leveling and shaping	\$2250 per acre		\$16,787
Fencing - exercise lots	\$1.75/linear foot		\$2,725
Free stall housing (including concrete, frame, roof, stalls, flush system and stanchions)		\$550	\$550,000
Solid separator w/concrete	\$30,000		\$30,000
Waste management system:			\$78,597*
Settling basin	\$5,537		
Retention lagoon	\$51,995		
Storage lagoon	\$14,895		
Pipe	\$6,170		
Center-pivot irrigation rig	\$27,500		\$27,500
Irrigation pump	\$18,500		\$18,500
Equipment & cost over-runs	9% of total cost		\$85,891
200 additional irrigated acres	\$700 per acre		\$140,000
TOTAL COST		950.00	\$950,000

Source: Pagano et al.

*Calculated using methodology from Schwart and Laceywell.

Table 2: Estimated Annual Cash Flow for a Representative Open Lot Dairy

	PER-COW COST OR REVENUE	PER-CWT COST OR REVENUE	ANNUAL TOTAL	GRAND TOTALS
REVENUES				
Milk sales	\$2273	\$12	\$2,727,950	
Animal sales [*]	\$271	\$1.43	\$324,800	
TOTAL REVENUES	\$2733	\$13.43		\$3,052,750
EXPENSES				
Animal purchases [*]	\$400	\$2.11	\$480,200	
Feed	\$1031	\$5.44	\$1,237,421	
Labor [*]	\$168	\$0.89	\$201,520	
Other operating costs	\$586	\$3.09	\$703,500	
Debt service [*] (mortgage and operating loan only)	\$270	\$1.43	\$324,345	
TOTAL EXPENSES	\$2,546	\$12.96		\$2,946,987
RETURNS TO EQUITY AND MANAGEMENT	\$88	\$0.47		\$105,764

Source: Pagano et al.

Table 3: Estimated Annual Cash Flow (Without Risk) for a Representative Free Stall Dairy

	PER-COW COST OR REVENUE	PER-CWT COST OR REVENUE	ANNUAL TOTAL	GRAND TOTALS
REVENUES				
Milk sales	\$2457	\$12	\$2,947,946	
Animal sales [*]	\$271	\$1.32	\$324,800	
TOTAL REVENUES	\$2728	\$13.32		\$3,272,746
EXPENSES				
Animal purchases [*]	\$400	\$1.95	\$480,200	
Feed	\$1095	\$5.35	\$1,314,419	
Labor [*]	\$168	\$0.82	\$201,520	
Other operating costs	\$583	\$2.85	\$699,666	
Debt service [*] (mortgage and operating loan only)	\$270	\$1.32	\$324,345	
TOTAL EXPENSES	\$2517	\$12.29		\$3,020,151
RETURNS TO EQUITY AND MANAGEMENT (without free stall investment costs)	\$211	\$1.03		\$252,595
Annual cost of financing the free stall facility (15 year loan at 8 percent)			\$110,988	
NET CASH FLOW				\$141,607

Source: Pagano et al.

Table 4: Anticipated Annual Net Returns (Without Risk) from a Free Stall Investment

	Net Change	Total Change
Additional Revenues and Savings:		
Net increase in milk sales	\$219,996	
Net savings for lot maintenance and fly control	\$24,000	
Additional Costs:		
Net increase in milk hauling fees	less \$20,166	
Net increase in feed costs	less \$76,999	
GROSS CHANGE IN RETURNS TO EQUITY AND MANAGEMENT		\$146,831
Less the annual cost of financing the investment		less \$110,988
NET CHANGE IN RETURNS TO EQUITY AND MANAGEMENT		\$35,843

Source: Pagano.

Table 5: Expected Annual Net Returns from Investing in Free Stall Dairy Technology

OUTCOME	ODDS (chance of occurring)
Losing more than \$200,000	11 in 100
Losing \$200,000 to breaking even	32 in 100
Breaking even to earning \$100,000	20 in 100
Earning \$100,000 to \$200,000	18 in 100
Earning \$200,000 to \$400,000	16 in 100
Earning more than \$400,000	3 in 100
Most Likely added revenues	\$35,548

REFERENCES

Armstrong, Dennis. "Designs That Beat the Heat." Dairy Illustrated. 24, 2 (1992): 22-26.

Pagano, Amy Purvis. "*Ex Ante* Forecasting of Uncertain and Irreversible Dairy Investments: Implications for Environmental Compliance." Ph.D. dissertation. University of Florida. August, 1993.

Pagano, Amy Purvis, John Holt, Robert B. Schwart and William G. Boggess. "A Profile of Estimated Costs and Returns Associated with Free Stall Dairying in Central Texas." Food and Resource Economics Department Staff Paper, Number 93-13, University of Florida. May, 1993.

Schwart, Robert B., Jr. and Ronald D. Lacewell. "Dairy Waste Management Estimator Worksheet" and LAGOON software. Texas Agricultural Experiment Station, Texas Agricultural Extension Service, Department of Agricultural Economics, Texas A & M University, May, 1992.

Texas Milk Market Administrator. Texas Milk Market Report. Carrollton, Texas: Office of the Market Administrator, Federal Order 126. January, 1990 - June, 1993.

