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In This Issue: **Investment Decisions Require Economic Evaluation**

Investment Decisions Require Economic Evaluation

by

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Increased milk price and feed stuffs price volatility has milk producers scrambling to re-evaluate management goals. More than ever, dairy producers are concerned about maintaining short term cash flows, and the generation of an acceptable rate of return or a potential stream of returns over the life of new farm investments. The lure of new technology has producers wanting to adopt anything that promises to increase net cash flow by either reducing costs or increasing net income. Clearly some of these technologies make good on the promise of increased production at level or lower per unit costs, but producers must evaluate the costs and returns carefully before making the investment plunge. With the help of their records and a calculator or computer spreadsheet, producers can estimate the potential economic benefit from investing in some of these production increasing technologies. The evaluation presented here is to demonstrate a process for economic evaluation of an investment in cooling For the purposes of illustration we are using a hypothetical investment in a cooling system. We want to emphasize that this technique can be used to evaluate the economic feasibility of any investment.

Evaluating Cow Cooling

The summer heat in Texas is brutal to man and animal. The heat is directly responsible for drops in milk production per cow and lower conception rates. These two factors make cow cooling an appealing investment. The first thought is..."more milk and better conception... it's a no brainer!" A salesperson was overheard telling a potential customer.. "cash flow will cover it." Many producers that have installed cooling say the same. So those producers that are contemplating such an investment think if they

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make the same investment their cash flow will also cover the investment. These assumption are not always found to be correct after the investment is made.

A prudent manager will not invest in cooling or any other technology until he or she has evaluated the economic soundness of the investment. If the increased income or the cost savings generated by the investment in cooling alone will not pay for the investment then the investment should not be made. If the income increases and cost savings cannot be quantified, then the economic soundness of the cooling investment can not be evaluated. Cow cooling is worthy of economic analysis. It can pay for itself, but not every cooling system will pay for itself.

Data and Assumptions

The data used in this analysis of a cow cooling investment was obtained from discussions with fan salesmen, and dairy specialists, and best estimates by the authors based on Agriculture and Food Policy Center, Texas A&M University panel farm data and discussions with panel members. The cooling investment analyzed is for 1,000 cows housed in a free stall. Cooling is accomplished using fans and a wetting system. The total cost of the system is for a turnkey operation and includes equipment, hardware, plumbing, wiring, and labor. Each dairy producer must use his or her data to evaluate a potential investment in cooling.

Every investment must pay for itself either by adding income or reducing costs. For the purposes of this analysis, added income results from increases in milk production per cow, milk per cow recovered due to higher lactation curves that result from better conception rates, and milk per cow recovered due to fewer premature cullings within a lactation. The cost savings that result from installing cooling are: savings in vet and medical costs per cow, savings in breeding cost per cow, cost savings that result from shorter dry periods per cow, and savings resulting in the losses in cow value due to premature culling. Table 1 presents the income data used in this analysis.

There are increases in production costs that result from investing in cooling. Also, there are added production costs associated with the increased milk production due to cooling. There is the added cost of electricity associated with running the fans, and there are added repairs. Table 2 presents the cost data used in this analysis. The process of analysis begins with a partial budget.

The Partial Budget

The partial budget is used to analyze the net returns generated from the investment. The partial budget is composed of four parts: Part one is the added income from the investment; part two is the reduced cost from the investment; part three is the added cost from the investment; part four is the reduced income from the investment. Figure 1 presents the partial budget. Notice, the budget does not contain an analysis of the cost of the cooling system itself, nor the cost of financing. A cash flow budget will be used to analyze these costs.

In this analysis, the installation of the cooling system added a total of eight pounds of milk per cow per day. Four pounds of this eight pound increase resulted from a cooler environment during the 150 days of extreme temperatures. Two pounds results from cows getting bred earlier and showed up as a slightly higher lactation curve over the entire 316 day lactation. Another two pounds resulted from better cow condition and health which results in fewer early lactation cullings. This milk is over the entire lactation. A gross milk price of $12.00 is used, based on projections of sum the Class III price and the producer price differential. For purposes of budgeting, it is recommended a very conservative price projection be used. It is also advisable to budget with a range of prices and expected milk production increases, so you have a fairly complete picture of the profitability of the investment. This analysis is very easy using a computer spreadsheet. The cost of producing milk is estimated to be $11.55 per cwt. of milk produced. Again, it is prudent to estimate production costs conservatively, and to use a range of costs. Figure 1 presents the partial budget used in this analysis and a template for you to insert you own data.

Purchasing and Financing the Cooling System

Based on discussions with equipment dealers and dairy specialists we estimate that we would need 100 fans for a 1,000 cow free stall barn for a total cost of $50,000. While many dairy producers this size would pay this amount in full at completion of the installation, for the purposes of illustration we are assuming that the producer puts $10,000 down and finances the remaining $40,000 for three years. In this example the producer is making three annual payments and borrowing the money needed for 8.75 percent interest.

Figure 2 presents the financing worksheet to determine the annual loan payment. We calculated the loan payment using the loan payment function, **"PMT"**, in an Excel spreadsheet. Figure 3 presents an amortization worksheet for determining the interest and principal payments each year. We calculated the principal payment for each period using the principal payment function, **"PPMT"**. We subtracted the principal payment from the loan payment to determine the interest payment each period. It is important to determine the interest paid each year because the interest is used to determine the tax savings accrued from the investment. There is an alternative method for calculating the principal payments each year.

For the first year of the loan we will pay 8.75 percent interest on the entire outstanding loan balance of $40,000. This amount is $3,500, by subtracting $3,500 from the loan payment of $15,731.83 we determine the net loan balance after the first year of $27,768. Multiplying this balance by 8.75 percent, obtain an interest payment for the second year of $2,429.71. Subtracting the interest payment from the loan payment yields a principal payment of $13,302.12. Subtracting the principal payment from he loan balance yields a new loan balance of $14,466. Multiplying this balance by 8.75 percent yields an interest payment of $1,265.78. Subtracting the interest payment form the loan payment yields a principal payment of $14,466. This amount is the final payment on the principal.

Depreciation and Tax Savings

Figure 4 presents the depreciation work sheet. Discussions with fan company representatives indicate that cooling equipment has a useful life of seven years. Using a seven year life we are assuming that we are allowing the investment to pay for itself in seven years. Depreciation is a cost to the business and is a tax deductible expense. A straight line depreciation schedule is presented. To calculate annual depreciation, divide the total cost of the investment by the years of useful life. In our example, we divided $50,000 by seven to obtain an annual depreciation of $7,142.86. Depreciation is not a cash flow item, but it is used to calculate tax savings which is a cash flow item.

Figure 5 presents the tax savings worksheet. Both interest expense on the investment loan and depreciation are business expenses that are tax deductible. To calculate the tax savings from the investment in cooling, multiply the sum of the depreciation and interest expense for each year by your marginal tax rate (in the example it is 28%). The result is your annual tax savings. This amount is included on your cash flow.

Cash Flow

To determine if the investment in the new technology is feasible, we constructed a cash flow statement (Figure 6). From the partial budget, we determined that for each of the seven years of useful life of the cooling system, we expect the cooling system to generate an annual net return of $10,888 from the investment in the cooling system. We must cover the annual principal and interest payments from the annual net return. We subtract the annual principal payment and the annual interest payment from annual net returns. We add the expected tax savings and the result is the expected net after tax cash flow. In this example, we have a negative cash flow for each of the first three years of the investment. Over the entire seven year payout we expect the investment to earn us a total of $35,035. Normally, a positive cash flow total would indicate the investment could be made, but this investment might not be feasible. The net cash flow is negative for the first three years. This situation may create a financing problem for the producer if the current cash flow without the investment is just narrowly positive. Remember, that the cash flow we are analyzing in this analysis is the result of the investment alone. If the new investment alone cannot cover its own cash flow, then it should not be made.

Discounting the After Tax Net Cash Flow

How does this investment compare to an alternative investment? We can determine the value of the investment by discounting the expected after tax net cash flow for each period and summing those discounted values. The discount rate is the expected rate of return we would receive from an alternative investment. The net present value that results from investment in fans is$17,934.81. As long as this value is greater than zero, then it is a viable investment however, it might not be feasible (see above). In this example, we used $10,000 we had, as a down payment. If we had invested the $10,000 in a certificate of deposit for seven years at a rate of 8.25 percent we would have at the end of those seven years $17, 477.18 in our account. In other words we would have earned a total return of $7,477.18. If we invested $40,000, at 8.25 percent for seven years, the balance is in our account would total $69,671.53. Investing $50,000 for 7 years at 8.25 percent , our account would have $87,089.41 in it. Figure 5 presents the discount factors needed for each of seven periods for several selected interest rates. Multiplying the net cash flow for each period by the discount factor for each period results in the net present value for that period.

More on Discounting

Discounting the after tax net cash flow allows you to compare the flow of returns from this investment, with an another investment alternative. The discount rate you use should reflect a rate of return you expect from an alternative investment. The sum of the discounted net income stream is an indication of how much the producer would need to invest today to yield the net income stream generated by the investment. A positive discounted net present value stream is acceptable. A negative value indicates the producer should not make the investment. A zero indicates the producer has a choice of investments. In this example, the sum of the net present value of the income stream is negative.

In this example the discount rate is 8.25 percent. The standard discount formula

$$1/(1+r)^{n}$$

was used where "r" is the discount rate and the "n" is the year, or period, to which the formula is applied. The value "r" in this example is .0825. If "n" is 1 then the value of the formula for the first year is 0.9237875289. It was calculated by dividing 1 by the value $(1+r)^{n}$. To calculate the value of (1+r), add .0825 + 1 which equals 1.0825. The value of the discount formula for the second year is 0.8533833985.

The value of $(1+r)^{n}$ for the second year is calculated as follows:

$$(1..0825)^{2} = 1.17180625$$

1 divided by 1.17180625 = 0.8533833985

In Summary

The pressure to stay competitive encourages dairy producers to adopt technologies that promise more cash flow. To stay competitive, producers should strive to control costs of production and even lower the cost of production. Many times producers adopt promising or popular technology based on the experiences of other producers. Sharp producers will evaluate the economic consequences of a potential investment before committing the resources to that investment.

We have presented here a technique to evaluate technology adoption. To illustrate the procedure we used a hypothetical investment in a cooling system. The results in this paper are not to be used as the results for every situation. We want to emphasize that the results we obtain in this illustration are the result of the assumptions we made when we began the analysis. Dairy producers that use this procedure to analyze a potential investment will be using their own data from their own dairy operations and data supplied by the sales rep for the company selling the technology. For questions regarding the procedure here, contact the authors or the Extension economist serving your county. The County Extension Agent in your county can help you reach these people.

Table 1: Income Data					
Item	Pounds per Day	Average Number of Cows Milked	Effective Days	Expected Gross Price	Total Dollars per year
Milk yield per cow per day	4.0	1,000	150	$12.00	$72,000
Milk recovered from better conception and condition	2.0	1,000	316	$12.00	$75,840
Milk recovered from fewer cullings	2.0	1,000	316	$12.00	$75,840

Table 2: Cost Data					
Item	Pounds per Day	Average Number of Cows Milked	Effective Days	Expected Costs	Total Dollars per year
Milk yield per cow per day	4.0	1,000	150	$11.55	$69,300
Milk recovered from better conception and condition	2.0	1,000	316	$11.55	$72,996
Milk recovered from fewer cullings	2.0	1,000	316	$11.55	$72.996
	Number of Fans	Cost per Month	Number of Months		
Electricity per fan per month	100	$30.00	5		$15,000
Repairs	100				$500

Figure 1: Partial Budget

Partial Budget	Example				
	pounds per day	avg. nr. of cows milked	effective days	expected price	total dollars per year
I. Income increases					
1. Milk yield per cow per day due directly to cooling	4.0	1,000	150	$ 12.00	$ 72,000.00
2. Milk recovered from better conception rates and condition	2.0	1,000	316	$ 12.00	$ 75,840.00
3. Milk recovered from fewer cullings	2.0	1,000	316	$ 12.00	$ 75,840.00
4. Other					
5. Other					
Total Income Increases					$ 223,680.00
II. Cost savings					
1. Vet costs per cow per year		1,000	365	$ 4.00	$ 4,000.00
2. Breeding costs per cow per year		1,000	365	$ 5.00	$ 5,000.00
3. Dry period ration per cow per day per period		1,000	5	$ 1.00	$ 5,000.00
4. Cow turnover losses in value per cow per year		1,000	365	$ 4.00	$ 4,000.00
5. Other					
Total Cost Savings					$ 18,000.00
III. Total of sections 1 and 2					$ 241,680.00
IV. Added costs					
1. Milk yield per cow per day due directly to cooling	4.0	1,000	150	$ 11.55	$ 69,300.00
2. Milk recovered from better concentration rates and condition	2.0	1,000	316	$ 11.55	$ 72,996.00
3. Milk recovered from fewer cullings	2.0	1,000	316	$ 11.55	$ 72,996.00
	number of fans	cost per month	number of months		
4. Electricity per fan per month	100	$ 30.00	5		$ 15,000.00
5 Repairs	100				$ 500.00
Total Added Costs					$ 230,792.00
V. Reduced income					
1					
Total of sections 4 and 5					$ 230,792.00
Net returns					$ 10,888.00

Figure 1 Continued

Partial Budget	Your Numbers				
I. Income increases	pounds per day	avg. nbr. of cows milked	effective days	expected price	total dollars per year
1. Milk yield per cow per day due directly to cooling					
2. Milk recovered from better conception rates and condition					
3. Milk recovered from fewer cullings					
4. Other					
5. Other					
Total Income Increases					
II. Cost savings					
1. Vet costs per cow per year					
2. Breeding costs per cow per year					
3. Dry period ration per cow per day per period					
4. Cow turnover losses in value per cow per year					
5. Other					
Total Cost Savings					
III. Total of sections 1 and 2					
IV. Added costs					
1. Milk yield per cow per day due directly to cooling					
2. Milk recovered from better concentration rates and condition					
3. Milk recovered from fewer cullings					
	number of fans	cost per month	number of months		
4. Electricity per fan per month					
5 Repairs					
Total Added Costs					
V. Reduced income					
1					
Total of sections 4 and 5					
Net returns					

Figure 2:Financing Worksheet

Financing Worksheet		
	Example	Your Purchase
Total Purchase Price	$ 50,000.00	
Down Payment	$ 10,000.00	
Net Financed	$ 40,000.00	
Number of Years Financed	3	
Number of Payments	3	
Interest APR	8.75%	
Payment per Period	($15,731.83)	

Figure 3: Amortization Worksheet

Example Loan Amortization Worksheet				
Year	Total Loan payment	Principal Payment	Interest Payment	Outstanding Balance
0				$ 40,000
1	($15,731.83)	($12,231.83)	($3,500.00)	$ 27,768
2	($15,731.83)	($13,302.12)	($2,429.71)	$ 14,466
3	($15,731.83)	($14,466.05)	($1,265.78)	$ (0)
4				
5				
6				
7				

Your Loan Amortization Worksheet				
Year	Total Loan payment	Principal Payment	Interest Payment	Outstanding Balance
0				
1				
2				
3				
4				
5				
6				
7				

Figure 4: Depreciation Worksheet

Depreciation Schedule			
		Example	Your Purchase
	Value of purchase	$ 50,000.00	
	Expected economic life of the equipment	7	
	Type of depreciation used	straight line	
	Year	Amount	Amount
	1	$ 7,142.86	
	2	$ 7,142.86	
	3	$ 7,142.86	
	4	$ 7,142.86	
	5	$ 7,142.86	
	6	$ 7,142.86	
	7	$ 7,142.86	

Figure 5: Tax Savings

Tax Savings Worksheet											
Example						My Tax Savings					
Year	Tax rate	Depreciation	Interest	Total Expense	Tax savings	Year	Tax rate	Depreciation	Interest	Total	Tax savings
1	28%	$ 7,142.86	$ 3,500.00	$ 10,642.86	$ 2,980.00						
2	28%	$ 7,142.86	$ 2,429.71	$ 9,572.57	$ 2,680.32						
3	28%	$ 7,142.86	$ 1,265.78	$ 8,408.64	$ 2,354.42						
4	28%	$ 7,142.86	$ -	$ 7,142.86	$ 2,000.00						
5	28%	$ 7,142.86	$ -	$ 7,142.86	$ 2,000.00						
6	28%	$ 7,142.86	$ -	$ 7,142.86	$ 2,000.00						
7	28%	$ 7,142.86	$ -	$ 7,142.86	$ 2,000.00						
		$ -	$ -	$ -							
		$ -	$ -	$ -							
		$ -	$ -	$ -							
		$ -	$ -	$ -							
		$ -	$ -	$ -							

Figure 6: Cash Flow

Example Cash Flow Budget							
Year	Expected Cash flow Stream	Annual Principal Payment	Annual Interest Payment	Expected Tax Savings	After Tax Net Cash Flow	Discount Factor	Discounted After Tax Cash Flow
0	$ (10,000)				$ (10,000.00)	1	$ (10,000.00)
1	$ 10,888	$ (12,232)	$ (3,500)	$ 2,980	$ (1,863.83)	0.9237875289	$ (1,721.78)
2	$ 10,888	$ (13,302)	$ (2,430)	$ 2,680	$ (2,163.51)	0.8533833985	$ (1,846.31)
3	$ 10,888	$ (14,466)	$ (1,266)	$ 2,354	$ (2,489.41)	0.7883449409	$ (1,962.52)
4	$ 10,888	$ -	$ -	$ 2,000	$ 12,888.00	0.7282632248	$ 9,385.86
5	$ 10,888	$ -	$ -	$ 2,000	$ 12,888.00	0.6727604848	$ 8,670.54
6	$ 10,888	$ -	$ -	$ 2,000	$ 12,888.00	0.6214877458	$ 8,009.73
7	$ 10,888	$ -	$ -	$ 2,000	$ 12,888.00	0.5741226289	$ 7,399.29
Total	$ 66,216	$ -	$ -	$ -	$35,035.00		$ 17,934.81

Figure 6 Continued

Your Cash Flow Budget							
Year	Expected Cash flow Stream	Annual Principal Payment	Annual Interest Payment	Expected Tax Savings	After Tax Net Cash Flow	Discount Factor	Discounted After Tax Cash Flow
0							
1							
2							
3							
4							
5							
6							
7							
Total							