Agriculture
Extension UtahStateUniversity

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January 2020 AG//Dairy/2020-01pr

A Financial Analysis of Alternative Levels of Facility Investment Associated with Installing an Automatic Milking System

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Robotic or Automatic Milking Systems (AMS) first started to appear in Europe in the 1990s with adoption in the U.S. following about 10 years later. These systems are designed to increase labor efficiency on a dairy herd and may also be associated with increased production per cow. However, these systems do require a substantial capital investment per cow; it is a classical capital for labor tradeoff that has been a part of agriculture for decades. Are AMS more profitable than conventional parlors?

A survey of Minnesota and Wisconsin AMS dairies was done in 2017 and they were compared to conventional parlor dairies. The survey results demonstrated that smaller AMS dairies were more profitable than parlor dairies due primarily to the inefficient use of the parlor. For larger dairies, AMS were not more profitable (Salfer et al. 2017). A 2018 study in Iowa found that a 216-cow dairy, installing three AMS units had a positive net annual financial impact, but a negative impact on cash flow, compared to a conventional parlor (Bentley, Schulte and Tranel, 2018). Both the Minnesota and Iowa studies found that their results were very sensitive to assumptions on milk production changes, labor savings, and capital investment in facilities. So, it appears that in some scenarios AMS are more profitable than conventional parlors and as dairy producers continue to install more AMS, they must believe they are at least equally profitable.

Construction Alternatives When Installing an AMS

The Minnesota and Wisconsin study also found that building new facilities tailored to the AMS and designed to minimize labor, altered milk production changes compared to a minimally retrofitted facility and, therefore, the level of facility investment could play a role in how profitable the AMS was.

This fact sheet models some of the key variables impacting profitability of AMS and explicitly considers three different levels of capital investment in facilities in addition to the capital cost of the AMS. The specific objective is to determine how the level of capital investment in additional facilities impacts the profitability of an AMS.

Utah State University recently installed an AMS in a newly constructed, fully enclosed cattle housing facility. The greatest potential for efficiency gains from AMS are generally found when combined with fully enclosed barns where there is minimal human disturbance and cattle can free flow to AMS, feed, water and resting areas. However, these types of fully enclosed facilities also represent the most significant capital investments. Are the most efficient fully enclosed barn facilities the most economical or does some other level of facility investment have the potential for greater returns?

To answer this question, a partial budgeting framework was used to calculate the net financial impact, which is the sum of the positive financial impacts less the sum of the negative financial impacts and includes depreciation and interest costs associated with the AMS system and the barn to house the system. The change to total cash flow under three facility investment scenarios is also determined. All three AMS scenarios assumed a 144-cow dairy (milking 120 cows) requiring two robotic milking units. Each AMS was purchased for $190,000 with a useful life of 15 years, a salvage value of $40,000, and an estimated annual repair cost of $7,000. Averages were used over the last 10 years (2009-2018) for milk price, feed price, and interest rate (Table 1). The interest rate used was the FED prime rate and 2 percent and 3 percent markups were added to the prime rate for the AMS equipment and facility loans, respectively. The 10-year average of the prime rate was 3.5%, so the interest rate was 5.5% on the robots (7-year loan) while for the barn construction, the interest rate was assumed to be 6.5% (15-year loan). Table 1 contains additional assumptions for each scenario.

Table 1. Assumptions in the Partial Budget Simulation for Each Scenario.

	CMS[1]	AMS[2] Scenario		
Variable	Value	1	2	3
Current Hours of Milking Labor (hrs/day)	9			
Anticipated Hours of Milking Labor (hrs/day)		3	2	2
Current Hours of Heat Detection (hrs/day)	0.65			
Anticipated Hours of Heat Detection (hrs/day)		.40	.30	.25
Labor Rate ($/hour)	$15			
Reduced Feeding Labor (hrs/day)		0.0	0.3	1.0
Lbs. of Milk per Cow per Day	72.5			
Percentage Milk Production Increase		6%	10.5%	16%
Lbs. of Dry Matter per lb. of Milk	0.64	0.62	0.60	0.58
Feed Waste & Efficiency Savings ($)		2,860	10,431	22,377
Increased Feed Costs for Added Milk ($)		7,132	9,537	13,601
	Mean			
Milk Price ($/cwt)	17.91			
Feed Cost per lb. of Dry Matter ($/lb.)	0.12			
Prime Interest Rate (%)	3.53			

[1] CMS = Conventional Milking System
[2] AMS = Automated Milking System

Scenario 1 represents a minimal retrofit to existing facilities with cost of the facility retrofitting at $70,000. Scenario 2 involves the construction of a new open-sided milking barn at a cost of $470,000. For scenario 3 a new fully-enclosed barn was constructed at a cost of $920,000. The initial capital outlay obviously changes across the three scenarios, but perhaps less intuitive, milk productivity, feed efficiency, and labor savings also vary across the scenarios.

Which Level of Facility Investment Was Most Profitable?

Using the assumptions outlined previously, we calculated the net financial impact as well as the total change to cash flow under the three investment scenarios and summarized the results in Table 2. Initially, we would conclude that the third scenario has the greatest potential for a positive increase in net financial impact as well as the least negatively impacted cash flow. It is not shown here as part of

Table 2. Static Comparison of Net Financial Impact and Total Change to Cash Flow Under 3 AMS Scenarios.

Scenario	Net Annual Financial Impact	Total Change in Cash Flow
1. Minimal Retrofit	$6,659.00	-$19,263.00
2. New Build-Open Sided	$9,145.00	-$14,388.00
3. New Build-Fully Enclosed	**$10,485.00**	**-$10,365.00**

the analysis, but changes to cash flow can be neutralized by increasing the AMS loan payout period from 7 to 11 years for Scenario 1, 10 years for Scenario 2, and 9 years for Scenario 3. With these payout periods the change to cash flow is near zero for all three scenarios.

It would appear that the fully enclosed barn, which has the potential for the greatest efficiency gains, would be the most desirable investment strategy. However, one must consider that that strategy also requires the largest financial investment and some producers may be unwilling or unable to make this large of an investment. All three scenarios may fit what an individual producer wants to do and provide different levels of capital investment and risk that may match up better with an individual producer's financial position.

Conclusions

The results of the analysis indicate that we would expect all three scenarios to have a positive annual financial impact. However, this positive financial impact must be considered together with the projected total annual change in cash flow. Before any producer makes the switch to AMS, consideration must be given as to whether the farm has the ability to absorb the projected negative impact to cash flow until the loans can be paid down. Restructuring the loan payout period can alleviate some or all of the negative change to cash flow depending upon the payout period.

Each producer considering installing an automated milking system should also carefully evaluate their herd productivity and management style. Small changes to the assumptions made in this analysis can have fairly large impacts on the returns. If a producer has poor genetics in their herd that limit milk production, then installing a robotic milking system may do little to change milk productivity. Similarly, poor feed management or excellent feed management may impact the changes seen in feed costs after installing an AMS and constructing a new facility.

References

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