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Economic Costs and Labor Efficiencies Associated with Raising Dairy Calves for Operations Using Individual or Automated Feeding

2017

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INTRODUCTION

The cost of raising dairy replacement calves is a significant cost on Wisconsin dairy farms in the production of milk. Calculating the costs associated with raising dairy calves is an essential part of dairy business management. To augment individual dairy calf cost of production analysis, the dairy industry also requires a set of benchmark costs whereby individual business costs and labor and management efficiencies can be compared. The objective of this project was to evaluate the economic costs and labor efficiencies associated with raising dairy calves on Wisconsin and Minnesota dairy farms using an individual traditional system (bottle or bucket) compared to those using an automated milk feeding system.

METHODS

A computer model, Intuitive Cost of Production Analysis **(ICPA),** was written in 1997 and formally published in 2003 (MPS, 2003). A beta test of the ICPA model was conducted in 1999 and reported (Hoffman, et al., 1999) the costs of raising dairy herd replacements. In 2007 and 2013, ICPA field surveys were completed and reported (Zwald, et. al., 2007; Vanderwerff et al., 2013). Due to drastic changes in feed and calf prices an update of the 2013 survey was completed in 2015 (Akins et al., 2015). The previous surveys focused on differences in operation types rather than management. Recently, the use of automated milk feeding systems has increased but the cost of operating these has not been evaluated in Wisconsin. The current ICPA survey evaluated the cost of production for dairy farms using either individual feeding (n=11) or group feeding with an automated milk feeding system (n=15). The ICPA evaluation field input data were collected by 12-county based University of Wisconsin-Extension agriculture agents and two University of Minnesota-Extension agents. Data were edited for practical errors and entered into the ICPA model. Calf enterprise summary statistics were developed for each management category. Tables 1 and 2 summarize the cost of raising dairy calves (birth to time moved to group housing or out of group feeding pen).

To avoid variation in calf raising cost calculations solely due to the price of some common inputs, prices were pre-assigned to some of those inputs. Pre-assigned costs used in the ICPA model to calculate variable and opportunity costs for calf rearing enterprises are listed in Table A. All other values used to calculate variable costs were operation-specific.

Table A. Key Assumptions Used in Costs Associated with Raising Calves		
Item	**Unit**	**Value**
Calf Value	$/calf	200.00
Labor (paid and unpaid)	$/hour	13.00
Management (paid and unpaid)	$/hour	22.00
Interest Rate	%	4.50
Unsalable waste Milk	$/cwt.	8.00
Salable milk	$/cwt.	17.00

Because of large variations in the age, design, and condition of buildings and equipment on survey operations, no single method of determining fixed costs adequately fits all situations. In an effort to standardize determination of fixed costs for facilities across operations, a replacement value for calf facilities was assigned using the following guidelines (Table B).

Table B. Valuation of Calf Facilities (Replacement Value)		
Item	**Unit**	**Replacement Value**
Homemade Calf Hutch	$/hutch	200.00
Purchased Calf Hutch	$/hutch	400.00
Greenhouse Barn	$/square foot	10.00
Post-Frame Calf Barn	$/square foot	15.50

Most survey operations used facilities and equipment that were partially depreciated and were thus considered to have a practical alternative use. The following is a description of how fixed costs of facilities were determined for these circumstances.

Determining Annual Fixed Costs for Facilities (most common situation)
Step 1: Facilities were inventoried on participating farms and were assigned a current replacement value using the cost estimates above.

Step 2: The present value of facilities was calculated, considering the replacement value, age of the facilities and a 30-year useful life straight-line depreciation. If facilities were more than 30 years of age, five percent of the replacement value was used as the present value.

Step 3: Annual fixed cost of facilities were established using 15 percent of the present value to account for the annual costs of depreciation, interest, repairs, taxes, and insurance. These values, expressed on a per animal basis, are used and expressed in the cost of production tables (Tables 1 and 2).

Determining Annual Fixed Costs for Equipment
Step 1: Calf equipment was inventoried on participating farms, and the replacement value of all equipment was directly estimated by the owners.

Step 2: The present depreciated value of equipment was calculated considering the age of the equipment and straight line depreciation with a useful life of 20 years for non-motorized equipment and ten years for motorized equipment. Ten percent of the estimated replacement

value was used as the current value for non-motorized equipment older than 20 years and for motorized equipment older than ten years.

Step 3: Annual fixed cost of equipment was established using 15 percent of the present value to account for the annual costs of depreciation, interest, repairs, taxes, and insurance. These values expressed on a per animal basis are used and expressed in the cost of production tables (Table 1 and 2).

RESULTS

Comparison of the Costs Associated With Using Individual Milk Feeding or Group Feeding with Automated Feeder

Table 1 provides the total cost from birth to moving into a group pen or in the case of an automated feeding system out of the automated feeder pen. These data are not adjusted for days on feed thus a longer feeding period may result in a higher total cost. Table 2 provides the daily costs and is calculated by dividing the total costs by the number of days on feed.

The demographics of operations surveyed are in Table 1. The individual fed operations raised an average of 185 calves per year while the automated operations raised on average 486 calves per year. Operations were attempted to be matched by size, however there were five automated feeding operations that raised over 500 calves per year and one individual fed operation over 500 calves per year in this survey.

The average total allocated costs were lower for individual fed calves ($363.69) than calves fed using an automated feeder ($401.73). However, cost categories differed between systems with individual feeding systems generally having lower feed costs, higher labor costs, and lower fixed (housing and equipment) costs than operations using an automated milk feeder. The variable costs were similar between the 2 systems with the higher feed costs being compensated for by lower labor costs. The fixed costs (mainly the housing costs) were greater for group-housed calves fed with an automated feeder than individual fed calves. In addition, unpaid labor and management was greater for individual fed calf operations likely due to these operations having more unpaid labor from the owner or family members.

As expected operations using automated feeders were able to feed higher milk amounts and thus often have greater costs. In this study, individual fed calves were fed an average of about 80 lb milk replacer powder (range = 42 to 98 lb) or 855 lb whole milk (range = 548 to 1142 lb), while calved fed using an automated feeder consumed 134 lb milk replacer (range = 50 to 212 lb) or 921 lb whole milk (range = 725 to 1490 lb) from birth to weaning. Seven of the 12 operations using whole milk also fed a balancer with an average of 22 lb balancer powder fed in addition to whole milk. When converted to milk solids on 12.5 percent basis, calves on an automated feeder consumed an average of 131 lb milk solids which was similar to the intake of milk replacer powder. This shows considerable variation between the two systems but also within each feeding system and reflects differences in calf management. When feeding higher milk amounts, the use of pasteurized whole milk helped to reduce costs with average cost per pound at $1.34 per lb for milk replacer powder and $0.72 per lb whole milk solids. The pasteurizer cost ranged from $1 to 15 per calf and using an average of $7.50 per calf the additional cost per pound of

solids is $0.05 per lb whole milk solids for a total cost of $0.77 per lb pasteurized whole milk solids or per gallon of pasteurized whole milk (12.5 percent solids).

Labor costs were significantly reduced for operations using an automated milk feeding system with paid labor approximately $64 per calf and $104 per calf for operations using individual feeding. This is due to reduced time for prepping, feeding, and cleaning of calf feeding equipment. Automated feeding systems still require daily maintenance including pasteurizing milk, filling milk replacer/balancer, cleaning, and monitoring feed intakes. Management costs were similar between the two systems and emphasizes both require time for managing calves (identification, performance/disease monitoring, labor management). If unpaid labor and management are included the total labor and management cost per calf would be $104 for automated feeding systems and $172 for individual feeding. Considerable variation exists for both systems ($46 to 210 per calf for automated systems and $34 to 330 per calf for individual systems) and may be related to increased efficiency due to higher calf numbers raised and efficient feeding/cleaning systems.

Housing costs were greater for operations using automated feeders ($55.44 per calf) compared to individual systems ($26.41 per calf). Variation was higher for housing costs with automated feeding systems with some operations using renovated barns while others built new facilities with additional advanced technology. Operations which individually fed calves used hutches or calf barns with individual pens. Four operations used only hutches while five operations used only indoor individual pens and two operations used a combination of hutches and indoor individual pens. The age of facilities likely impacted the housing costs as operations with automated feeders were all less than 10 years old, and operations individually feeding calves had facilities older than 20 years, which were further depreciated. As automated feeding system facilities depreciate, it is expected that current housing costs will decrease. As expected, equipment costs per calf was slightly higher for using automated feeding systems. Table 1 provides automated feeding system purchase cost data per mixing unit (not per feeding station/nipple). The average purchase cost was $24,836 per unit with operations using 3-4 feeding stations per unit. There are differences in purchase cost and are likely related to the complexity of the system and feeding data it is able to collect.

In Table 1, data from operations with the lowest and highest total allocated costs within each system is provided. In the individual system, the highest cost operation fed high amounts of milk replacer (94 total pounds powder) with a 9 week weaning age. In addition this operation had higher paid labor costs per calf with a total of 15 hours labor and 2.3 hours management per calf compared to the average of 11.5 hours labor and 1 hour management per calf. The lowest cost operation using individual feeding fed 42 lb milk replacer powder over a 5 week period and with relatively low labor of 5.3 hours and 0.1 hour of management time. However, death loss was high for the lowest cost operation at 16.5%.

For the automated feeding system, the lowest and highest cost operations had some differences in variable costs with the high operation feeding higher amounts of calf starter and paying a portion of the calf labor while the low operation had no paid labor or management. Starter cost was high due to an extended time after weaning when calves were moved out of the automated feeder pen with weaning at 6 weeks and moving at 12 weeks and high starter intakes of 8 lb per day after weaning. Both the low and high operation used pasteurized milk and had a lower cost

than the average for all the automated operations. Another difference between these operations was the housing and equipment costs with the high operation having a newer calf facility with automated environmental controls and greater automated feeder purchase price.

HIGHLIGHT FINDINGS -2017

1. Operations using automated feeders had higher liquid feeding costs than individual systems due to their ability to easily feed higher milk amounts. Use of pasteurized whole milk reduced costs when feeding higher milk volumes even when partially using salable milk.
2. Labor costs were lower for farms using automated feeding systems than individual systems and compensated for the higher milk feeding amounts. Unpaid labor costs were higher for individual fed operations with these operations generally being smaller and having less hired labor.
3. Management costs were similar between operation types emphasizing the importance of calf management in either system.
4. Housing costs were higher for those using automated feeding due to newer, larger facilities. This difference may normalize as depreciation will occur as facilities age. Operations with the highest housing cost also had the highest total allocated costs. Planning for sufficient but not excessive facility space save costs of raising calves. Use of a renovated facility also may be an option for certain operations.
5. Variation exists for labor and housing costs for farms using automated feeding systems; therefore, suggesting different strategies to manage calves and improve employee comfort.

2017
Calf Enterprise Analysis Summaries
Costs associated with raising dairy replacement animals from birth until moved to group housing
Tables 1 and 2

Table 1. The cost and labor required to raise one calf by operation type (n=26).

		Operation Type							
		Individual				Autofeeder			
Cost	Unit	Average	SD	Low[2]	High	Average	SD	Low	High
Number of Operations	n	11				15			
Calves Raised	calves/year	185	173	23	620	486	609	77	2,466
Autofeeder Purchase Cost	$$/mixing unit	-	-	-	-	24,836	11,511	13,700	61,000
Variable Cost									
Liquid Feed	$$/calf	111.95	37.66	58.50	199.64	140.50	72.54	74.76	100.36
Calf Starter	$$/calf	53.26	24.82	53.90	61.15	60.96	53.60	43.32	159.26
Forage	$$/calf	0.32	0.81	-	2.63	0.54	0.81	-	1.31
Bedding	$$/calf	13.80	12.68	0.46	16.22	16.21	11.68	8.73	28.66
Veterinary	$$/calf	12.12	8.96	5.00	20.00	18.80	13.05	15.00	1.00
Death Loss	$$/calf	9.83	9.44	33.26	6.45	8.13	6.96	3.24	2.13
Interest	$$/calf	5.00	1.92	2.33	7.16	4.62	1.90	4.07	6.61
Paid Labor	$$/calf	103.95	93.73	34.89	195.14	63.74	56.03	-	52.83
Paid Management	$$/calf	12.57	18.70	-	-	10.39	10.75	-	-
Total Variable Cost	**$$/calf**	**322.80**	**121.59**	**188.34**	**508.39**	**323.89**	**111.84**	**149.12**	**352.16**
Fixed Cost									
Calf Housing	$$/calf	26.41	22.76	5.93	12.40	55.29	45.81	63.38	174.25
Calf Equipment	$$/calf	14.48	21.43	0.79	9.97	22.40	14.96	18.37	59.11
Total Fixed Cost	**$$/calf**	**40.89**	**36.94**	**6.72**	**22.37**	**77.69**	**59.02**	**81.75**	**233.36**
Total Allocated Cost (Variable Cost + Fixed Cost)	**$$/calf**	**363.69**	**130.44**	**195.06**	**530.76**	**401.58**	**138.39**	**230.87**	**585.52**
Opportunity Cost of Unpaid Labor & Mgt	$$/calf	55.93	91.41	36.44	50.84	29.61	51.36	85.94	93.04
Allocated Cost + Opportunity Cost of Unpaid Labor & Mgt	**$$/calf**	**419.62**	**131.45**	**231.50**	**581.60**	**431.19**	**169.43**	**316.81**	**678.56**
Opportunity Cost of Calf	$$/calf	200.00	-	200.00	200.00	200.00	-	200.00	200.00
Allocated Cost + Opportunity Cost of Unpaid Labor, Mgt, & Calf	**$$/calf**	**619.62**	**131.45**	**431.50**	**781.60**	**631.34**	**169.43**	**516.81**	**878.56**
Summary									
Feed Cost	$$/calf	165.53	52.93	112.40	263.42	202.00	99.27	118.08	260.90
Other Variable Cost (Excluding Labor and Management)	$$/calf	40.73	15.79	41.05	49.83	47.83	13.45	31.04	39.48
Labor/Mgt Cost (paid and unpaid)	$$/calf	172.45	93.09	71.33	245.98	103.47	51.17	85.94	141.77
Total Fixed Cost	$$/calf	40.89	36.94	6.72	22.37	77.68	59.04	81.75	233.36
Feed Cost	%	40.77	9.16	48.60	45.30	47.17	11.17	37.30	46.10
Other Variable Cost	%	10.50	4.43	17.70	8.60	12.05	4.04	9.80	5.13
Labor/Mgt Cost (paid and unpaid)	%	38.59	12.86	30.80	42.30	24.04	8.65	27.10	18.43
Total Fixed Cost	%	10.10	9.23	2.90	3.80	16.75	7.62	25.80	30.34
Labor/Mgt Required	days/year	278.78	316.13	115.60	97.40	369.41	435.86	56.90	280.50
Labor/Mgt Required	hrs/calf	12.53	6.86	5.40	17.30	7.40	3.74	5.90	8.83
Labor Efficiency	calves/hr	7.83	5.85	9.00	4.80	11.64	6.64	13.00	9.51
Labor Efficiency	calves/day	62.68	46.80	72.10	38.80	93.17	53.15	104.20	76.06
Weaning Age	weeks	7.86	1.48	5.00	9.00	7.96	1.12	8.00	6.00
Days on Feed (birth to moving)	days	70.32	14.21	49.00	84.00	67.85	12.96	77.00	84.00

[1] In this analysis, an animal was considered to be a calf until moved into a group or moved out of the automated feeder pen. Most of the other labels and terms in this table are explained in the glossary.

[2] Low and high cost values are from the operation with the lowest or highest total allocated costs within each operation type. These do not include the calves raised per year or autofeeder purchase cost data.

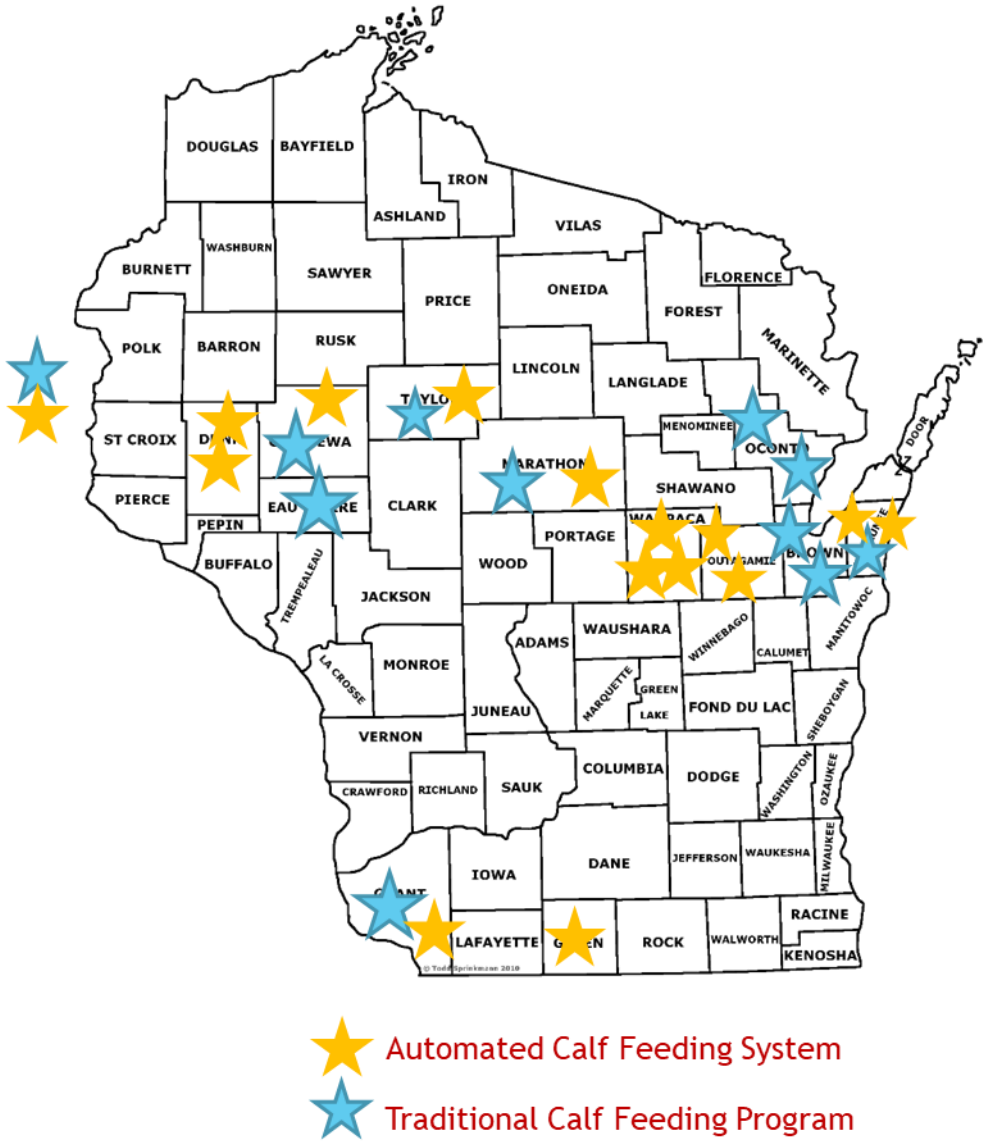
Table 2. Comparison of daily calf raising cost by operation type (n=26).[1]

		Operation Type	
Cost	**Unit**	**Individual**	**Autofeeder**
Number of Operations	n	11	15
Variable Cost			
Liquid Feed	$$/calf/day	1.60	2.08
Calf Starter	$$/calf/day	0.75	0.84
Forage	$$/calf/day	0.00	0.01
Bedding	$$/calf/day	0.20	0.24
Veterinary	$$/calf/day	0.17	0.29
Death Loss	$$/calf/day	0.15	0.13
Interest	$$/calf/day	0.07	0.07
Paid Labor	$$/calf/day	1.39	1.01
Paid Management	$$/calf/day	0.18	0.17
Total Variable Cost	**$$/calf/day**	**4.51**	**4.84**
Fixed Cost			
Calf Housing	$$/calf/day	0.39	0.80
Calf Equipment	$$/calf/day	0.19	0.33
Total Fixed Cost	**$$/calf/day**	**0.58**	**1.13**
Total Allocated Cost (Variable Cost + Fixed Cost)	**$$/calf/day**	**5.09**	**5.97**
Opportunity Cost of Unpaid Labor & Mgt	$$/calf/day	0.75	0.38
Allocated Cost + Opportunity Cost of Unpaid Labor & Mgt[3]	**$$/calf/day**	**5.84**	**6.35**

[1] In this analysis, an animal was considered to be a calf until moved into a group. Most of the other labels and terms in this table are explained in the glossary.

[2]The opportunity cost of the calf was omitted from this table to illustrate the daily costs per head.

Appreciation is expressed to the operations which provided data for the survey and the County Extension Agents who assisted with or directly collected data. This project took significant time to accomplish and would not have been possible without these agents or the operations. Below is a map showing the distribution of operations within counties in Wisconsin.



GLOSSARY OF TERMS

Allocated Cost - All costs (variable + fixed cost), except the opportunity costs. Opportunity costs include cost of unpaid labor, management, and calf value.

Allocated Cost + Opportunity Cost of Unpaid Labor & Management - The sum of total allocated costs (variable cost + fixed cost) plus the opportunity cost of unpaid labor and management.

Allocated Cost + Opportunity Cost of Unpaid Labor & Management, and Calf - The sum of allocated cost (variable cost + fixed cost) plus the opportunity cost of unpaid labor and management, plus the calf value. This term is used in heifer cost estimates only when combining calf and heifer costs to avoid double accounting for the value of the calf.

Bedding – Bedding materials, such as sand, sawdust, straw, or corn stalks which are used to bed calves or replacement heifers. The cost of bedding for operations using mattresses without bedding was zero, but the mattress was reflected in the fixed cost of the operation.

Calf - Youngstock on liquid feed prior to moving to group housing.

Calf Starter - Purchased calf starter or formulated grain mixes fed to calves.

Days on Feed (days) - The average number of days the calf was on feed.

Death Loss - For calves, the cost of death loss was estimated as the percent death loss multiplied by the calf value, plus expenses that accumulated to the age of death.

Feed Cost (%) - Feed cost expressed as a percent of total allocated cost plus unpaid labor and management.

Feed Cost ($/calf) - The sum of all feed costs for feeding a calf.

Fixed Cost (%) - Total fixed cost as a percent of total allocated cost, plus unpaid labor and management.

Fixed Cost ($/calf) - See total fixed cost, not including heifer portion.

Interest - An interest cost (4.5 percent annual) was calculated for other variable costs for the duration of the calf or heifer raising period to estimate the value of capital throughout the raising period.

Labor Efficiency (calves per day) - The number of calves that can be handled (labor and management) by one person working an 8 hour day.

Labor Efficiency (calves per hour) - The number of calves that can be handled (labor and management) by one person in one hour.

Labor & Management Cost (%) - Paid and unpaid labor and management expressed as a percent of total allocated costs, plus unpaid labor and management.

Labor & Management Cost ($/calf) - The total value of both paid and unpaid labor associated with raising a calf.

Labor & Management Required (hours per calf) - The number of hours required to raise one calf.

Liquid Feed - Whole milk, pasteurized waste milk, milk replacer or combinations used to feed calves. Unsalable waste milk had an assigned value of $8.00 per hundredweight and salable milk was $17.00 per hundredweight. If whole milk was fed, each operation estimated the percentage from unsalable and salable milk to calculate cost of whole milk fed.

Opportunity Cost of Calf - The estimated market price of the calf is considered an opportunity cost because there was the opportunity to sell the calf instead of raising it. In other words, in deciding to raise the calf, the owner gave up income from selling the calf--income that could later be used to offset costs of buying another calf. An economically successful business should be able to pay for all costs including realistic opportunity costs.

Opportunity Cost of Unpaid Labor & Management - Considered an opportunity cost because this labor or management time has earning potential if used in a different way such as milking more cows or performing another job. If calf labor or management is not hired or partially hired, the unpaid portion of labor and management is considered an opportunity cost. The value of unpaid labor and management was calculated by multiplying the estimated unpaid labor hours by $13.00 and the estimated unpaid management hours by $22.00. If all calf labor and management are hired, calf and heifer labor and management are a paid cost. In this analysis, paid labor and management costs are assumed to be variable costs. An economically successful business should be able to pay for all costs including realistic opportunity costs.

Other Variable Cost (%) - Total variable cost minus feed, labor and management costs expressed as a percent of total allocated cost plus unpaid labor and management. Includes bedding, veterinary, interest, and death loss costs.

Other Variable Cost ($/calf) - Total variable costs minus feed, labor and management costs for a calf. Includes bedding, veterinary, interest, and death loss costs.

Paid Labor - The cost of paid labor as estimated for labor hours per calf multiplied by $13.00 per hour.

Paid Management - The cost of paid management as estimated for labor hours per calf multiplied by $22.00 per hour.

Standard Deviation - The most widely used measure of the spread in a data set [how much variation there is from the "average" (mean)]. A large standard deviation indicates that the data points are far from the "average" and a small standard deviation indicates that they are clustered closely around the mean.

For example, the data sets {49, 51} and {1, 99} each have a mean of 50. Their standard deviations are 1, and 49, respectively. The first set has a much smaller standard deviation than the other one because its values are all close to 50. In a loose sense, the standard deviation tells us how far from the average the data points tend to be.

Total Fixed Cost - The sum of facility and equipment fixed costs based on current un-depreciated values of assets to reflect a fairly common situation. See methods for more information about calculation methodology. In the short run, all costs are fixed and in the long run, all costs are variable. Consequently, in any analysis, judgment must be used to determine which costs are considered fixed and which variable. In this project we exercised that judgment, and handled depreciation, interest, repairs, taxes and insurance associated with structures and equipment as fixed, because that represents the most common time frame of most people interested in the project results. All other costs excluding opportunity (unpaid labor and management, calf value) costs were handled as variable costs.

Total Variable Cost - The sum of all variable costs including feed, paid labor and management, and other variable costs. In the long run, all costs are variable. In the short run, all costs are fixed. Consequently, in any analysis, judgment must be used to determine which costs are considered fixed, and which variable. In this project we exercised that judgment, and handled depreciation, interest, repairs, taxes and insurance associated with structures and equipment as fixed, because that represents the most common time frame of most people interested in the project results. All other costs excluding opportunity (unpaid labor and management, calf value) costs were handled as variable costs.

Veterinary - Veterinary services, drugs, vaccinations, pregnancy checks, and other veterinary expenses associated with the cost of raising calves.

Weaning Age (weeks) - The average age of a calf when they stop receiving liquid feed.

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REFERENCES

Akins, et al., 2015. Economic cost and labor efficiencies associated with rearing dairy herd replacements on Wisconsin dairy farms. [Computer Model: Intuitive Cost of Production Analysis (ICPA)]. Research Report, UW Dept. of Dairy Science, UW Extension and Cooperative Extension. http://www.fyi.uwex.edu/heifermgmt/.

Hoffman, et al., 1999. Economic cost and labor efficiencies associated with rearing dairy herd replacements on Wisconsin dairy farms. [Computer Model: Intuitive Cost of Production Analysis (ICPA)]. Research Report, UW Dept. of Dairy Science, UW Extension and Cooperative Extension. http://www.fyi.uwex.edu/heifermgmt/.

MidWest Plan Service. 2003. Raising Dairy Replacements. MidWest Plan Service, Ames, IA.

Vanderwerff, et al., 2013. Economic cost and labor efficiencies associated with rearing dairy herd replacements on Wisconsin dairy farms. [Computer Model: Intuitive Cost of Production Analysis (ICPA)]. Research Report, UW Dept. of Dairy Science, UW Extension and Cooperative Extension. http://www.fyi.uwex.edu/heifermgmt/.

Zwald, et al., 2007. Economic cost and labor efficiencies associated with rearing dairy herd replacements on Wisconsin dairy farms. [Computer Model: Intuitive Cost of Production Analysis (ICPA)]. Research Report, UW Dept. of Dairy Science, UW Extension and Cooperative Extension. http://www.fyi.uwex.edu/heifermgmt/.