Economics of calf grower operations in relation to dairy-sourced day-old calf price and feedlot outcomes

by

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ABSTRACT

Holstein steers compose 15% of the U.S. beef supply despite several factors that place Holstein feeders at a disadvantage including higher calf mortality than traditional beef breeds. This study examined how to improve overall profitability via mortality reduction at a calf ranch. Reinvestment of profit margins to increase Holstein survivability, specifically by providing incentive for dairies to improve survivability, is worth further study.

A cattle owner's enterprise budget is constructed that uses ten-year average cash prices for live cattle, feed inputs, and yardage fees. The analysis revealed that financial breakeven occurs at a 13.44% calf mortality at the calf ranch, ceteris paribus. Additionally, for each 1.0% decrease in mortality leads to an increase in profitability by $14.45/head. A sensitivity analysis was conducted and revealed that at 10% mortality, a margin of $79.63 exists that can be reinvested, and $7.42 exists at 15% mortality.

The cattle owner may increase profits by incentivizing dairies in multiple ways. A pricing schedule that rewards dairies for directly reducing mortality at the calf ranch over a given time frame is the most direct, but the potential income may be inconsequential to dairies. A model that rewards processes at the dairy such as proper colostrum management and sterilization of the calves' umbilicus provides more consistent treatment across the multiple sources for bull calves. A third option is to combine bonuses and discounts with education for dairy maternity crews.

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CHAPTER I: INTRODUCTION

Finished Holstein beef accounts for nearly 15 percent of the overall U.S. beef supply (Schweihofer 2017). Although the Holstein breed is not optimal for beef production, there is a high and steady quantity supplied by dairies resulting in low-cost Holstein calves relative to conventional beef breeds. These relatively lower costs offset some of their disadvantages as beef animals.

Dairies breed milking cows annually to maximize milk production per animal. A typical Holstein cow produces optimal milk quantity for three to five lactation cycles which are approximately one year each. Because male calves are a by-product of milk production, they are sold for beef production. Dairy-sourced calves differ from beef-breed calves conventionally raised on cow-calf operations as they are often purchased as day-olds and delivered to calf grower operations that specialize in growing dairy-sourced calves to feedlot delivery weight. Feeders typically purchase male calves from the dairy and send them to a third-party calf ranch to be custom grown. The calf ranch raises calves for approximately 150 days to a target weight of 300-350 lbs./head bodyweight before shipment to the feeder to finish in the beef production system.

Calf buyers commonly require that animals survive seven days for the dairy to receive payment. The standard is high relative to transactions across the beef production supply chain, but neonatal calf mortality is also much higher than feeder-age calves. While survival rates for younger animals are naturally lower than those of more mature animals, the dairy industry overall experiences higher calf mortality than cow-calf operations. "…the reason for lack of improvements in neonatal survival stems from de-prioritization of the issue relative to other animal health and welfare concerns" (Mee 2013, p. 1038).

Within 48 hours of arrival at the calf ranch, blood samples are collected on all animals received. Total serum protein serves as a proxy for the presence of antibodies received from colostrum. A calf that has received sufficient colostrum outperforms its peers that have not received sufficient quantity or quality.

A dairy's revenue from calf sales is minor when compared to the dairy's core operation, providing relatively little economic incentive to improve male calf survivability. The current pricing structure is a flat rate per head heavily discounted from current beef prices, with no premium/penalty for health, weight, or care given to the calf before or after birth. A negative association may be drawn between poor beef prices and day-old dairy-sourced calves, which further disincentivize dairies from providing prenatal and post-partum care such as colostrum, navel sanitization, etc. Consequently, the calf ranch receives calves of suboptimal quality as observed in low total serum protein and associated high mortality.

Based on this scenario, there could be a pricing structure for day-old male calves that would incentivize dairies to improve perinatal care. The questions become: what profit margin is available to the calf buyer, assuming retained ownership through slaughter? And how can that margin be used to improve calf survivability?

1.1: Objective of Study

The main objective of this study is to estimate the profit margin of feeding dairy-sourced Holstein feeder cattle for beef production. A secondary objective is to determine how that profit margin could be used to improve calf mortality. To address the main objective, an enterprise budget is developed to identify the inputs and expenses required to bring Holstein calves from birth to harvest. The resulting profit margin is the amount available to invest in improvement of calves received from the dairy.

Common causes of calf death on a calf ranch will be examined along with correlating preventive methods and their associated costs.

1.2: Lifecycle of Holsteins for Beef Production

A Holstein's lifecycle is best represented by two stages—the calf ranch (grower phase) and the feedlot (feeding phase). A cattle buyer purchases a male Holstein calf at birth and contracts a third-party calf ranch to raise the calf from approximately 100 lbs. to 300-350 lbs. Once the calf has reached the 300-350 lbs., he is transported to the buyer's feedyard where the animal is fed until a finish weight at approximately 1,400 lbs. After reaching the final weight, the animal is sent to the slaughterhouse. Each stage presents its own risks, both economic and health, that must be accounted for in an accurate pricing model. We will examine the stages of development from birth to harvest and the expenses at each stage.

1.2.1: Stage 1: The Calf Ranch

On the dairy, as pregnant cows enter the close-up phase of gestation (two weeks prior to anticipated birth) they are transferred to a maternity pen where they are monitored for health risks, such as dystocia, by veterinarians or highly trained staff. Ideally, the calf is fed colostrum after birth. A calf's ingestion of colostrum is an important indicator of health, providing immune system support via the dam's antibodies in the colostrum since the there is no placental transfer of immunity to the fetus. Availability of dry, insulating bedding such as straw further reduces health risks to newborn calves. A 2003 study reported that damp calf housing compounds bedding contamination problems, especially when inadequately sanitized between successive occupants (McGuirk 2003).

Within the first twenty-four hours of birth, the calf is transported from the dairy to the calf ranch, where the calf is processed. Initial processing includes ear tagging, vaccination, umbilical care, weighing and emasculation via banding. After processing, the calf is introduced to the hutch phase, which lasts until approximately day 85 of life. The hutch is typically a 15ft^2 wooden or plastic four-sided shelter raised 4-6 inches off the ground for ventilation, and the floor is covered with straw for insulation during winter months. Calves are housed individually to reduce exposure to disease and competition for feed. A ration of milk replacer is provided in a bottle twice daily. Average daily gain at this phase is slightly less than one pound per day, resulting in a one-month old calf weighing approximately 125 lbs.

On day twenty-nine of life, the calf is transferred to a larger hutch through day 85. Dry feed mix (alfalfa, corn silage) is introduced to the diet early, to encourage the calf to begin eating dry feed. Animal health is monitored by veterinarians daily. Average daily gain during this phase is still approximately one pound per day, resulting in a calf weighing 180 lbs. by the time of weaning from milk.

Approximately day eighty-five, the calf is moved to a large grow pen where commingling occurs. Milk replacer is removed from the diet and the dry matter composition of the ration is increased and delivered in a feed bunk. The higher rations allow the average daily gain to increase to approximately 2.6 lbs. which results in a 150-day old calf weighing approximately 350 lbs.

Upon completion of the third phase, the calf weighs 300-350lbs. and is ready for shipment to the feedyard. Calves are monitored closely for signs of poor health such as pinkeye, lameness, and chronic respiratory disease that would not be acceptable to the feedyard. Smaller, or sick animals, are retained in a separate holding pen where they are continued to be fed to the required weight and treated if necessary.

1.2.2: Stage 2: Feedyard

Calves are shipped via cattle truck in groups of approximately 145 head to meet the maximum vehicle weight allowed in the United States (e.g., 48,000 lbs. load). Due to lack of feed and water during transport, and a stressful environment, cattle lose approximately 9% bodyweight in a 24-hour period (Self and Gay 1972). Transport is stressful to the calves and results in immune challenge.

Upon arrival at the feedyard, the animals are weighed, vaccinated, and treated if necessary, before introduction to the final phase of growth before harvest. The steers are introduced in groups of 80 head to a large pen where they are allotted 18 inches of bunk space and approximately 275 ft^3 pen space per head, although this varies with region and climate. Holsteins require special consideration at a feedyard due to their large frame size and distinct behaviors such as playfulness and bulling, which increases airborne dust. At approximately 500 days of life (363 days on feed), the steer finishes at 1,300-1,400 lbs. of bodyweight. If harvested to early, the rib section will not have time to fill out. If allowed to grow beyond 1,500 lbs., the animal becomes too large to be processed in the same facilities as conventional beef-breed steer.

1.3: Overview of Study

In Chapter 2, a literature review will be presented to discuss how Holstein steers perform in the beef production system. Breed-specific considerations such as diet, efficiency and carcass grading are material to profitability. Chapter 3 will outline the materials and methods used to construct a budget to estimate the profit margin available to the feeder/cattle owner. Chapter 4 will provide the results of the budget and discuss potential applications of the data to include where further study is necessary.

CHAPTER II: LITERATURE REVIEW

The peer-reviewed literature available on raising Holsteins for beef production is extensive, but primarily examines the performance of the animal at the feedyard at a weaned weight of 600-700 lbs., similar to animals sourced from cow-calf operations, or follows an 850 lb. steer sourced from a stocker/feeder operation. Thus, data and studies have limited application to dairy calves raised on a calf ranch in place of a traditional cow-calf operation.

What follows is not a complete survey of the prior research related to Holstein beef production; however, the studies cited provide a foundation and comparison for the development of a budget suitable for sensitivity analysis. Emphasis of this review is on the factors that affect the economic viability of Holsteins as beef animals, and specifically, the opportunities that exist to reduce calf mortality at the calf ranch. A comparison of beef breed performance at the feedlot and the packing plant is also presented to provide a benchmark to evaluate Holsteins.

2.1: Holsteins for Beef

Rust and Abney (2006) examine several studies that agree on the comparability between Holstein steer performance and conventional beef breeds, principally Angus. Although some studies cited suggest differences in Holstein marbling, most research shows a consistent advantage in feed conversion and carcass-to-carcass USDA grading consistency for Holsteins. These data are well-documented; however, the market discounts Holsteins for inconformity with consumer expectations for desired cut shapes, lower dressing percent, and lower percentage of valuable cuts from the rib and loin areas (Rust and Abney 2006). Research from Cornell University found Holstein steers had 5.28% less meat yield compared to small-frame Angus steers at the same shrunk weight. Principal drivers are an increased gut proportion, reduced marbling score and reduced subcutaneous fat (Schweihofer 2017). These studies are helpful in identifying the disparity between beef quality and marketability, and explain the discounted price used in the pricing model.

2.2: Holstein-specific Steer Feeding Program

A sound understanding of the nutrition requirements for Holstein steers is necessary groundwork to develop a pricing system that includes feed efficiency rates specific to Holstein steers intended for beef production. Key differences in Holstein characteristics versus traditional beef breeds should be noted when formulating feed rations. Some key differences typical of Holstein steers are lower average daily gain (ADG) (2.76 lbs. vs. 3.18 lbs.), higher water consumption, greater risk of liver abscesses and acidosis and death loss (Duff and McMurphy 2007). Since 2007, feedlot ADG has improved, but Holsteins are still outperformed by beef breeds by a similar margin. It should be noted that while Holsteins experience a lower ADG, average daily feed intake (ADFI) is lower than beef breeds. Acidosis and liver abscesses are primarily due to the number of days on high-energy feed rations. However, acidosis can be mitigated by including ionophores such as Rumensin in feed and low-dose treatment with antibiotics has been shown to reduce liver abscess severity and incidence (Grant and Mader n.d.).

Duff and McMurphy (2007) examined data gathered by the VetLife Benchmark Performance Program to compare Holstein feedlot performance to conventional beef breeds. This study reported ADG derived from several ration mixes. Table 2.1 reports the results, which summarize key differences—most notably days on feed and mortality.

Table 2.1: Holstein Steer Performance Relative to Traditional Beef Breeds

Item	Beef Steers	Holstein Steers
In-weight (lbs.)	739	499
Out-weight (lbs.)	1262	1296
Days on feed	164	289
ADFI (lbs.)	20.2	18.2
ADG (lbs.)	3.18	2.76
Feed/gain ratio	6.42	6.65
Cost of gain ($)	0.53	0.58
Death loss (%)	1.33	2.75

Source: Duff and McMurphy (2001)

2.2.1: Non-dietary Considerations for Holsteins

Beta-adrenergic agonists, which are widely used in feedyards, have been shown to improve the narrow ribeye shape characteristic of Holsteins (Duff and McMurphy 2007). Beta-adrenergic agonists are found in Ractopamine hydrochloride and zilpaterol, which are added to the finishing ration. In a series of four studies for Elanco Animal Health, it was discovered that a 200 milligrams per day supplement of Ractopamine improved ADG by 17.9% and feed efficiency by 14.4% (Vogel, et al. 2007). An estrogen or estrogen-like growth-promotant implant such as zeralanone or estradiol benzoate (RalGro) may be administered every 100 days to improve muscle growth and feed efficiency.

2.3: Indicators of Calf Health

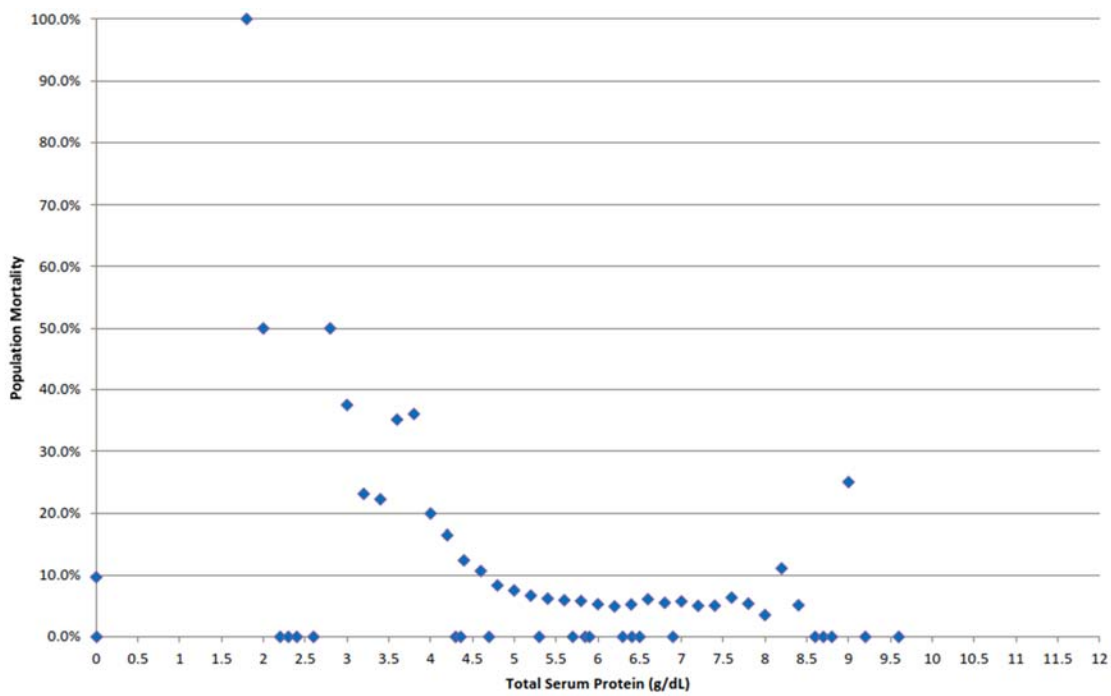
On day one at the calf ranch, two variables that are predictive of an animal's survivability from receipt at the ranch to harvest: total serum (bloodborne) proteins and body weight on arrival. When the calves are received at the calf ranch, individual body weight is measured, and a blood sample is collected.

Total serum protein (TP) is a proxy indicator for whether an animal has received sufficient colostrum. Colostrum feeding is the means by which newborn calves acquire passive immunity against infectious agents. The ability of a newborn calf to absorb colostral antibodies is limited to the first few hours of life. Colostrum contains nutrients, antibodies and growth factors. Antibodies provide passive immunity to the newborn calf, and the growth factors stimulate growth of the gut. For the colostrum to be optimally beneficial to the calf, it must be received in sufficient quality and not diluted (Besser and Gay 1994). Dairies typically do not allow the calf to nurse after birth, but collect the colostrum, which is mixed with that from other cows, pasteurized, and fed to newborn calves. If dairy management fails to feed the calves sufficient colostrum, their passive immunity is reduced and therefore, they are more susceptible to infection.

A 2019 Michigan State University study found that of the 23 dairy farms observed, 41.9% of calves (bulls and heifers) experienced a failure of passive transfer of immunity. Only 19.5% of colostrum samples met the study's standards for immunoglobin content and microbiological quality (Abuelo, et al. 2019). Dairies often sell colostrum for a high price relative to milk. Good dairy management necessarily involves a colostrum program to support calf health.

In 2014, Feedlot Health Management Services (FHMS) conducted an internal study on 49,219 calves to determine colostrum effects on calf mortality. Figure 2.1 shows that the population observed with TP of 4.0 grams (g) per deciliter (dL) experienced 20% mortality between arrival at the calf ranch and harvest, whereas the sample population observed at 4.5 g/dLs experienced approximately 11% mortality. Peak survivability of 94.3% was observed in the population testing >5.6 g/dL. The sample population exhibiting <5.2g/dL had the highest odds ratio for mortality at 1.76, indicating a strong relationship between failure of passive transfer and mortality. The >5.6 g/dL population's odds ratio was 1.00 showing less relationship between animal mortality and serum protein >5.6 g/dL. Regression analysis of the population testing <5.2 g/dL returned a p-value of <0.01, prompting a rejection of the null hypothesis that calves testing <5.2 g/dL do not suffer higher mortality than peers with higher total blood proteins at arrival to the calf ranch.

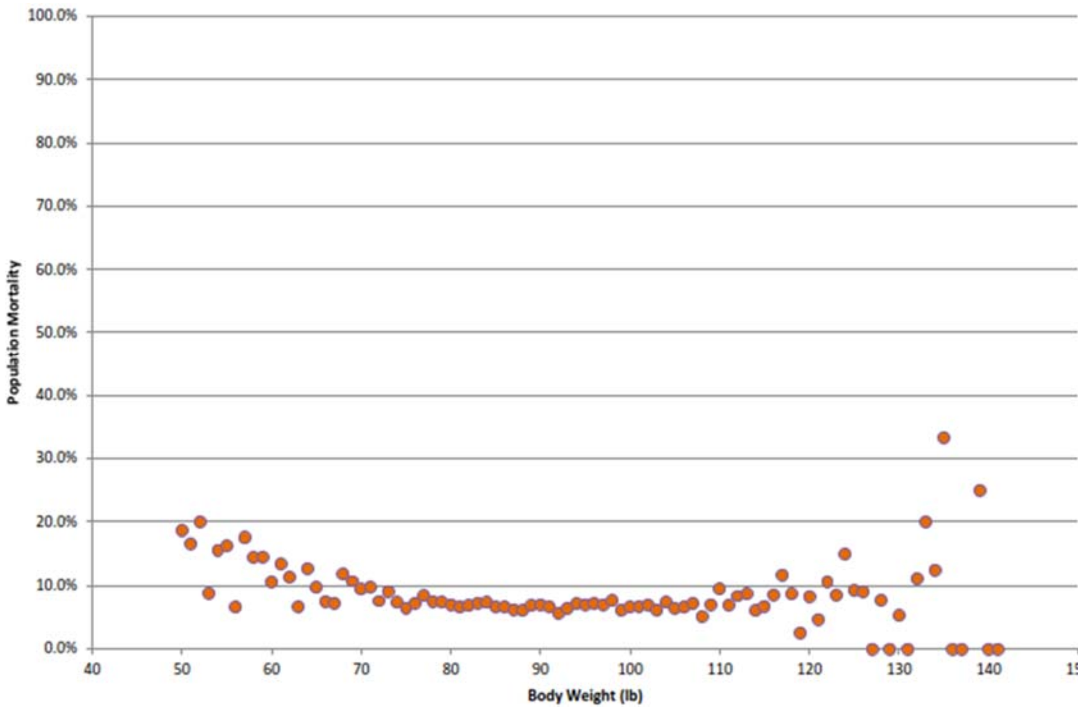
Figure 2.1: Relationship of Total Serum Protein and Mortality



Source: Feedlot Health Management Services (2016)

Calf bodyweight upon arrival to the calf ranch is also predictive of the animal's survivability, as shown in Figure 2.2. As found in the same internal study, the population with an arrival bodyweight <79 lbs. showed higher mortality of 8.4% than ≥79 lbs., with an odds ratio of 1.24. Populations with higher bodyweights showed lower odds ratios, indicating less relation with mortality. While low calf weight can be due to several causes, proper management of the dam's prenatal nutrition and environment mitigate low birth weight.

Figure 2.2: Relationship of Bodyweight on Arrival and Mortality



Source: Feedlot Health Management Services (2014)

2.4: Healthcare of the Neonatal Calf

In addition to providing colostrum to newborn calves, dairies can take several other measures to improve calf health. Dry, sanitary conditions in the maternity area must be a priority especially in colder, wetter months. Trained, attentive maternity crews should monitor peri-partum cows for signs of dystocia (difficult and/or prolonged birth), which together with hypoxia (deficiency of oxygen perfusion) accounted for 53.5% of recorded deaths in a U.S. study (Mee 2013). A trained crew can assist in prolonged births by orienting calves properly in the birth canal and extracting calves from the birth canal when necessary.

Ohio State University's Dairy extension also recommends treating the newborn calf's umbilicus with a 7% iodine tincture to dry and sanitize the tissue as the umbilicus is very susceptible to infection until total closure. An improperly sanitized umbilicus can lead to several diseases including septicemia, arthritis due to infection and peritonitis (Shoemaker 2007).

2.5: Relationship of Study to Existing Research

This research is intended to provide the Holstein calf buyer with tools to estimate profit margin and identify possible opportunities to reduce mortality at the calf ranch. Existing research examines the first questions but does not specifically consider differences inherent to the calf ranch model that sources day-old calves for beef production.

CHAPTER III: MATERIALS AND METHODS

This chapter will detail the sources and methodologies used to develop the budget variables.

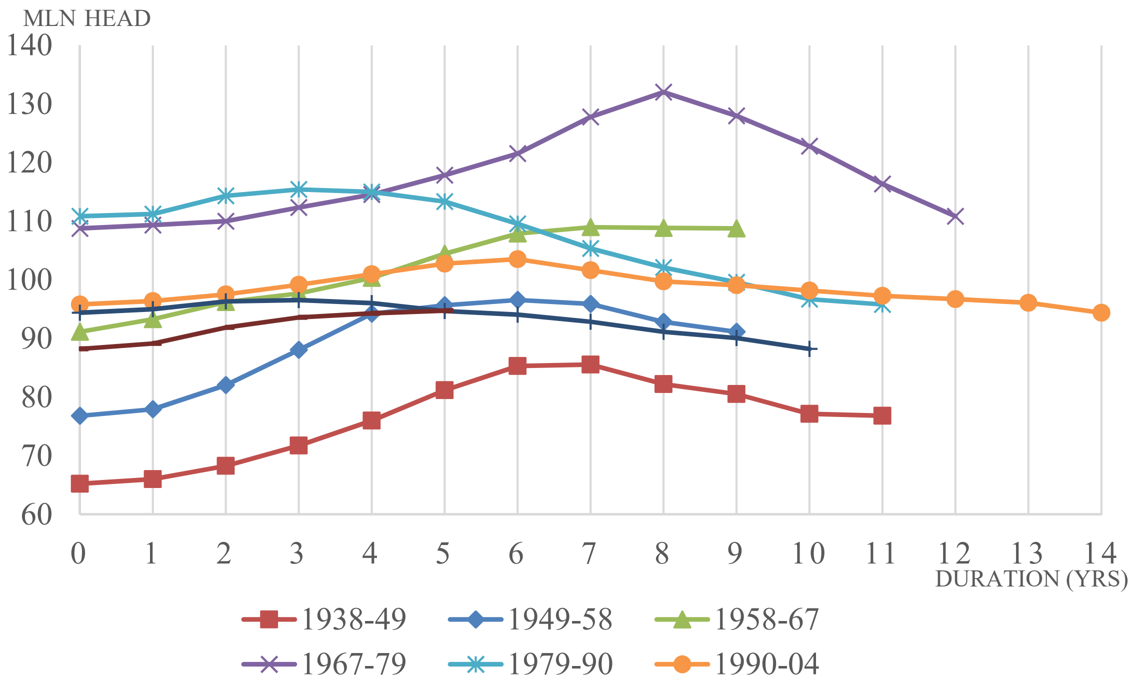
3.1: Enterprise Budget of Holstein Steer Life Cycle

A detailed pricing model of production inputs and beef prices is appropriate to identify the profit margin available to incentivize improvement of the health and overall performance of calves during the growing phase and subsequent finish feeding phase. This enterprise budget captures the primary expenses that the owners incur during the respective phases to raise a Holstein steer from birth to harvest. Expenses, such as purchase price of the animal and feed are itemized, whereas operating expenses such as overhead, labor, etc. are covered under a yardage fee of $0.25/day in the model. Yardage cost assumes the feeder marks up feed for a small margin.

The input prices used were based on a ten-year historical average to most accurately capture the commodity market cycle. As shown in Figure 3.1, the observed marketing cycle for beef supply in the United States lasts between seven to fourteen years, with an average duration of almost 10 years (LMIC 2020).

Price information is sourced from various market areas around the United States, and so The Law of One Price is assumed throughout the study. "The Law of One Price takes into account a frictionless market, where there are no transaction costs, or legal restrictions, the currency exchange rates are the same, and that there is no price manipulation by buyers or sellers. The Law of One Price exists because differences between asset prices in different locations would eventually be eliminated due to the arbitrage opportunity" (Chappelow 2020).

Figure 3.1: Total U.S. Cattle Inventory by Cycle



Source: Livestock Marketing Information Center (2020)

3.2: Animal Cost and per diem at Calf Ranch (Growing Phase)

Calf ranch pricing models vary widely as each may offer different services or contracting details. Table 3.1 itemizes the stages and transportation cost from the calf ranch. The price range of $2.15-$2.40/head/day is taken from three similar calf ranches in Southern Idaho. The price includes all feed and veterinary care for the dairy steers. There is no increase of price as variable costs such as feed and bedding are increased as the animal grows. The shipping cost assumes a load of 137 head steers at 300 lbs. each. The shipping rate of $4.00/mile for 1,000 miles results in a per-head transportation cost of $29.20.

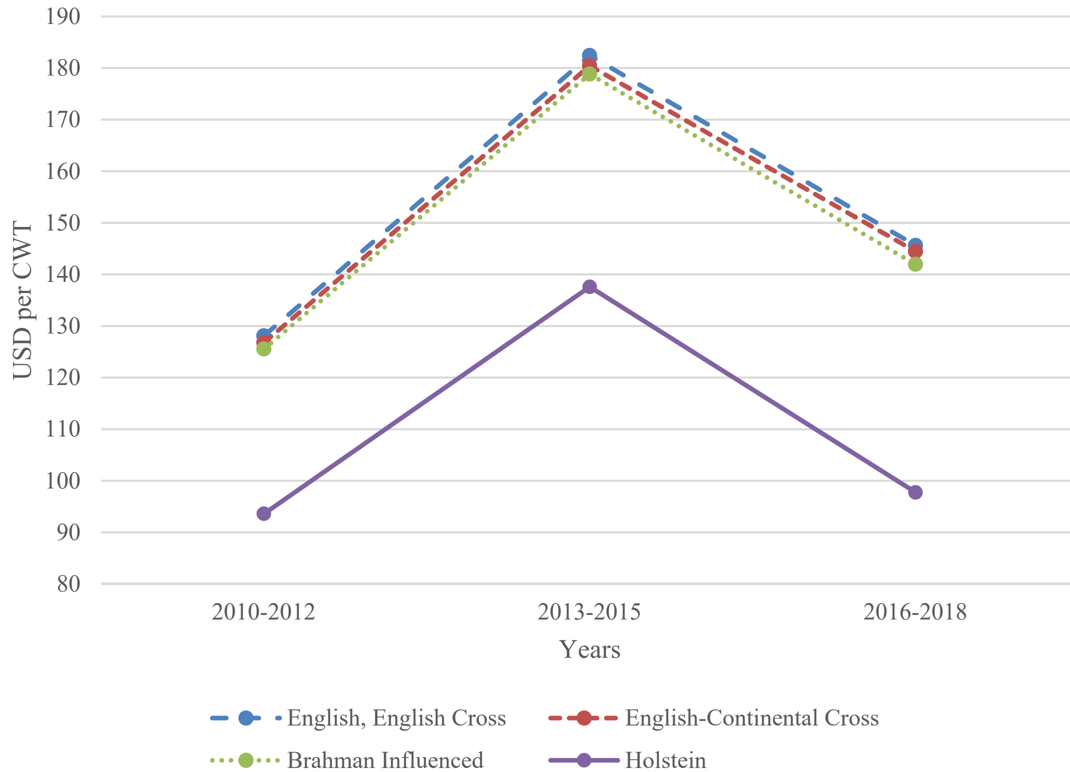
Table 3.1: Calf Price, Ranch Per Diem and Shipping Expense

Stage	In Weight (lbs.)	Duration	Cost/day	Cost of Stage	
Birth		1		***$ 30.00***	
Sm Hutch: day 1-28	100	28	$ 2.15	$ 60.20	
Lg Hutch: day 29-84	125	57	$ 2.15	$ 122.55	
Grow Pen: day 85-150	180	65	$ 2.15	$ 139.75	
Shipping to Feedyard				$ 29.20	
				$ 381.70	***Total/hd***

3.3: Live Cattle Prices and Assumptions

As discussed previously, Holstein cattle are discounted by the packer for unconformities with the traditional beef breeds typically processed in major slaughter/processing plants. As seen in Figure 3.2, Holstein feeder steers received an average discount compared to other breed descriptions of beef steer lots between 2010-2018 of $41.83/cwt. Data were taken from the sales prices for Holstein feeder steer lots relative to other breed descriptions sold through Superior Livestock video sales from 2010-2018 (McCabe, et al. 2018). The data's applicability is limited, since the observed calves varied between 500-700 lbs. bodyweight, and had not been started in the feeding phase of the beef production system. The heavy discount of $41.38/cwt is used as a worst-case scenario for this study's purposes. In personal communications with multiple calf ranch owners, the discount price for finished steers (1,300-1,400 lbs.) has been $6 to $20/cwt. This study assumes a $14.00/cwt discount as baseline. Historical cash prices were used since hedging and market risk management fall outside of the scope of this study.

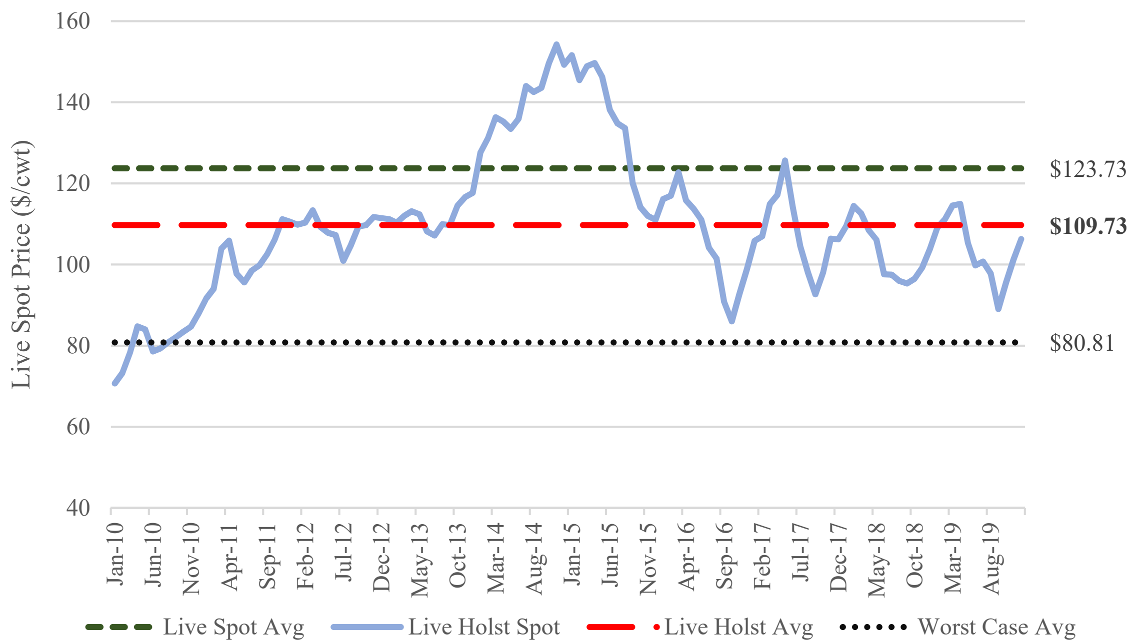
Figure 3.2: 500-700 lb. Feeder Steer Prices: Holstein vs. Conventional



Source: McCabe et al (2018)

Figure 3.3 shows the average monthly live cattle price between 2010-2019 of $123.73/cwt. Average price used in the budget was adjusted for the $14.00/cwt discount Holstein animals receive in the current market, resulting in an average historical price of $109.73/cwt for Choice-grading Holstein steers weighing 1,350 lbs. on a live-weight basis. The worst-case discount of $41.38/cwt as discussed above results in an average price of $80.81. Historical beef price data were obtained from Iowa State University's Ag Decision Maker, that publishes prices for Iowa & Minnesota choice-graded live steers (Iowa State University Extension and Outreach 2020). Use of the monthly average beef price captures the market volatility while reducing the effect of day-to-day movement related to speculation and micro-events. The live cattle cash price is intended to capture the current price of a finished beef steer in the U.S. corn belt without any defects that could be discounted by the packing house.

Figure 3.3: Live Cattle Spot Prices Adjusted for $14.00/cwt Holstein Discount



Source: Livestock Marketing Information Center (2020) and Cody Morgan (2020)

3.4: Mortality Rates at Calf Ranch and Feedlot

The focus of this study is to isolate calf mortality at the calf ranch, so mortality is divided into two categories—at the calf ranch and at the feedlot. Average mortality at the calf ranch is difficult to estimate because different dairies and calf ranches track the number differently. Multiple southern Idaho dairy managers, a southern Idaho calf ranch owner, and a feedlot consultant were interviewed separately by the author to determine a general range of 10% to 15% mortality at the calf ranch. The model assumes a 12% calf mortality. Mortality at the feedlot is assumed to be 2.5%, as reported by Duff and McMurphy (2001).

3.5: Base Ration Model Used

Feed rations for beef production vary widely geographically, dependent upon feedstuff availability and price. Although nutrient requirements for Holstein cattle on feed are largely similar to those of conventional beef breeds, some distinctions should be made in the feedyard to achieve optimum efficiency and grade.

The rations used in this thesis research are based primarily on a prescription from Iowa State University's Beef Cattle Handbook that specifically looks at "pee-wee" Holsteins—250-350 lb. calves intended for beef production. Because 300 lb. Holstein calves have been accustomed to a feedlot environment at the calf ranch, gradually introducing a high-energy ration, as required for traditional beef breeds, is not necessary. An all-grain diet is prescribed that is supplemented by a protein source such as soybean meal. As reported by Iowa State University's Beef Production Extension Center in the Beef Cattle Handbook, "When fed high corn diets, Holstein steers usually grade Choice at 1,050-1,200 lbs." (Grant and Mader n.d., p. 2). Dairy steers are typically fed to 1,350 lbs. to fill out the rib section and reduce the discount as discussed in Figure 3.3.

A 2014 study conducted at Utah State University compared different diets and the associated effect on ADG and feed-to-gain ratio (F/G), (Table 3.2). The study observed that feeder calves receiving a ration of steam-flaked corn (SFC) experienced higher ADG compared with whole and cracked corn or other grains, so SFC was used as the grain where prescribed by the Beef Cattle Handbook.

Table 3.2: Alternative Ration and Cattle Performance for 850-1250 lb. Yearling Steers

Ration #	**1**	**2**	**3**	**4**	**5**	**6**
	All values are in pounds, except Days Fed					
Corn, Whole	18			10		
Corn, Flaked		18			10	
Barley, Flaked			18			10
Alfalfa, full bloom	6	6				
Alfalfa/Grass Hay			6	16	16	16
Salt & Minerals	1	1	1			
Avg. Daily Gain	3	3.25	2.85	2.1	2.25	1.95
F/G as fed	8.25	7.66	8.85	12.44	11.68	13.51
Days Fed	133	123	140	190	178	205

Source: Utah State University (2014)

3.5.1: Commodity Prices & Assumptions

Prices of corn, soybean meal, and supplements are included as they are common components of feedyard rations for finishing beef cattle. Prices were obtained from Livestock Marketing Information Center for a uniform reflection of 10-year historical prices in the United States. The tool developed for this analysis can be adjusted to determine feasibility of different diets such as corn silage, distiller’s grain, etc. Sensitivity analysis of the several variables is also presented in chapter 4. For brevity, only the dietary components prescribed by Grant and Mader (n.d.) are analyzed here.

Various pricing structures exist for custom-fed cattle, but typically one of three methods are used: per diem per head, feed mark-up, feed consumed plus yardage, or a combination of the two. For simplicity, this study assumes pricing to be feed consumed plus yardage. Yardage cost used here is $0.25/head/day, assuming consistently large placement of cattle throughout the year. Dairies provide cattle consistently year-round that can decrease the fixed cost of operating a feedyard.

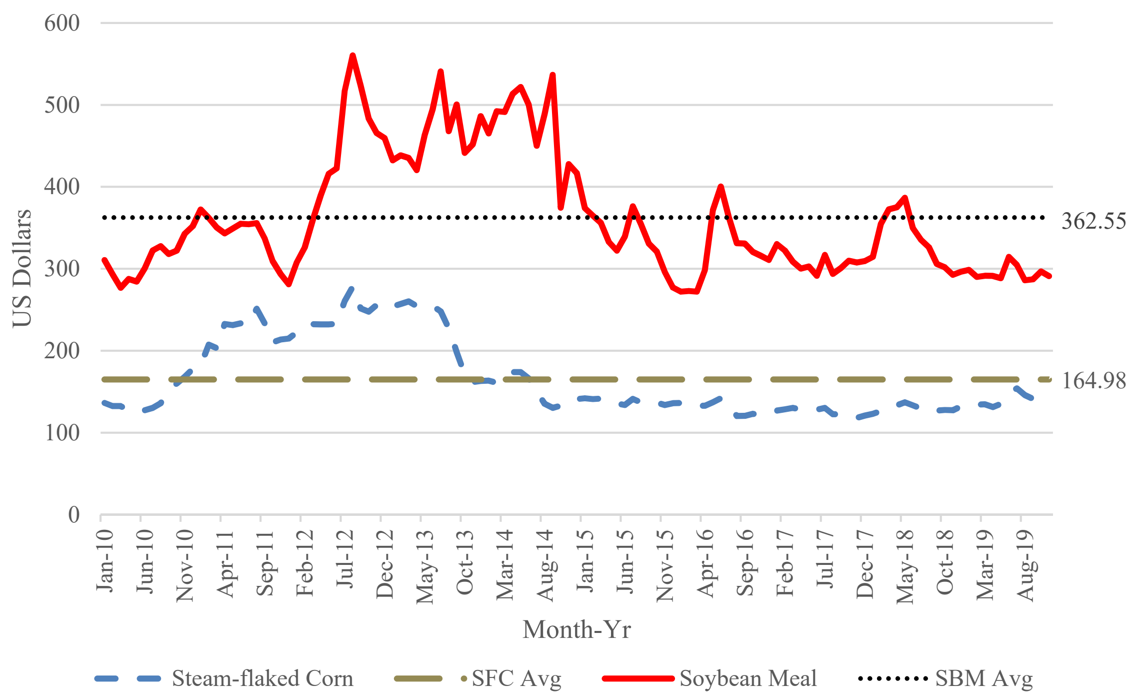
While the commodity prices for grain corn are based on USDA standard of 90% dry matter (DM), other feed inputs are less standardized. The average percentage of DM per unit as reported by the UC Davis Extension for the California Certified Organic Farms (CCOF 2015) is provided in Table 3.3 to allow for reconciliation between purchased commodity volume, and the dietary components, which are strictly recorded and presented in DM content across all cited sources. To accurately reflect the cost-of-gain, feedlot management samples every load received for DM content and adjust ration mixture accordingly. Table 3.3 shows the effect that average DM content has on price, since rations are calculated by DM, not gross tonnage.

Table 3.3: Observed Feed Moisture Effect on Price

	Price/Ton	Price/lb.	Dry Matter	Price/DM lb.
Steam Flaked Corn (SFC)	$164.72	$0.08	87%	$0.093
Soybean Meal Protein	$361.94	$0.18	91%	$0.197
Dry Distillers Grain (DDG)	$162.44	$0.08	90%	$0.089
Alfalfa Hay (Hay)	$171.30	$0.09	90%	$0.094
Salt & Mineral	$256.80	$0.13	100%	$0.128

Source: California Certified Organic Farms (2015)

Figure 3.4: Feed Commodity Prices 2010-2019
Source: Livestock Marketing Information Center (2020)



Historic prices are presented to support the decision tool that calculates gross margin. Entering the simple average of each commodity is not a true representation of any moment in time, as relationships exist between the pricing of commodities. The simple average does, however, provide a baseline for analysis. As such, the average prices used in the budget for SFC and soybean meal are $164.98/ton and $362.55/ton, respectively. Table 3.4 shows the cost-of-gain (COG) during the feedlot stage, which is approximately 363 days in duration. Cost-of-gain is estimated to be $0.80/lb.

Table 3.4: Cost-of-Gain at Feedlot: All Grain Diet

Age (days)	Days Fed	Animal Wt.	ADG	Ration Wt.	SFC	SFC Cost	Mineral	Mineral Cost	Soymeal	Protein Cost	Yardage	Daily Feed Cost	
Starting Ration			**2.40**	**2.12%**	**84%**		**1%**		**16%**		**$ 0.25**		
150	1	300	2.4	6.4	5.4	$ 0.50	0.1	$ 0.03	0.99	$ 0.20	$ 0.25	$ 0.72	
213	64	451	2.4	9.6	8.1	$ 0.75	0.1	$ 0.04	1.49	$ 0.29	$ 0.25	$ 1.08	
Grow Ration			**3.00**	**2.75%**	**92%**		**1%**		**8%**		**$ 0.25**		
214	65	454	3.0	12.5	11.5	$ 1.06	0.1	$ 0.05	1.02	$ 0.20	$ 0.25	$ 1.31	
296	147	700	3.0	19.2	17.7	$ 1.64	0.2	$ 0.08	1.58	$ 0.31	$ 0.25	$ 2.03	
Finishing Ration			**3.00**	**2.40%**	**94%**		**1%**		**6%**		**$ 0.25**		
297	148	703	3.0	16.9	15.9	$ 1.47	0.2	$ 0.07	0.98	$ 0.19	$ 0.25	$ 1.73	
512	363	1348	3.0	32.3	30.5	$ 2.83	0.3	$ 0.13	1.88	$ 0.37	$ 0.25	$ 3.32	
						$ 616.18		**$ 28.56**		**$ 97.77**	**$ 90.75**	***$ 833.25***	***Total feed cost***
												1,047.60	***Total lbs gained***
												$ 0.80	***Cost of gain/lb.***

**all weights in lbs*

CHAPTER IV: RESULTS AND DISCUSSION

Chapter 4 discusses the results of the enterprise budget per the methodology that has been outlined in chapter 3, followed by a sensitivity analysis of the variables that compose it. Finally, potential solutions to mortality at the calf ranch will be presented.

4.1: Profit Margins at Various Mortality Percentages

An enterprise budget supported by research literature and relevant cattle operations shows how calf mortality affects profitability, and what margin exists to improve it. Table 4.1 presents a range of profitability, given the most likely mortality rates on a calf ranch, which is the highest health risk phase of production. Financial breakeven mortality, assuming all operating costs are captured in the yardage expense is 13.44%.

Table 4.2 shows that every 1.0% decrease in calf mortality leads to an additional $14.45/head, ceteris paribus. Assuming the spectrum of calf mortality experienced by calf owners interviewed, reaching a practical goal of 10% would increase the profit margin by $49.64/head. Assuming the price of a day-old Holstein bull calf is $30, there is opportunity to financially incentivize dairies to improve calf health.

As discussed in Section 2.4, two indicators of calf health are birthweight and TP. Both indicators can be managed by dairies to some degree. Total serum protein levels in the calf can be improved at little cost to the dairy, mostly requiring better collection, management, and administration of colostrum of adequate volume and quality to the calf. Calf birthweight can also be influenced, though to a lesser extent, by correctly managing the diets and health of pregnant cows. Cows are bred in a time cycle that allows for them to be non-lactating or “dry” for 60 days. Because these cows are not producing milk, their feed rations are reduced to be more cost effective. While most dairies employ or contract a nutritionist, dry cow feed should not be reduced to the point of sacrificing calf birth weight, which obviously affects both bull calves and replacement heifers, which are much more valuable to the dairy producer.

Table 4.1: Effect of Mortality at Calf Ranch on Gross Margin, $/head

Mortality	**10%**	**11%**	**12%**	**13%**	**13.44%**	**14%**	**15%**
Live weight (lbs)	1,350	1,350	1,350	1,350	**1,350**	1,350	1,350
Price/lb	$ 1.10	$ 1.10	$ 1.10	$ 1.10	**$ 1.10**	$ 1.10	$ 1.10
Mortality (calf ranch)	10.0%	11.0%	12.0%	13.0%	**13.4%**	14.0%	15.0%
Mortality (feed yard)	2.50%	2.50%	2.50%	2.50%	**2.50%**	2.50%	2.50%
Gross Revenue	$ 1,299.88	$ 1,285.43	$ 1,270.99	$ 1,256.55	**$ 1,250.24**	$ 1,242.10	$ 1,227.66
Expenses							
Day 1 Bull calf	$ 30.00	$ 30.00	$ 30.00	$ 30.00	**$ 30.00**	$ 30.00	$ 30.00
Calf ranch	$ 322.50	$ 322.50	$ 322.50	$ 322.50	**$ 322.50**	$ 322.50	$ 322.50
Feedlot	$ 833.25	$ 833.25	$ 833.25	$ 833.25	**$ 833.25**	$ 833.25	$ 833.25
Freight & Hauling	$ 64.49	$ 64.49	$ 64.49	$ 64.49	**$ 64.49**	$ 64.49	$ 64.49
Expense	$ 1,250.25	$ 1,250.25	$ 1,250.25	$ 1,250.25	**$ 1,250.25**	$ 1,250.25	$ 1,250.25
Gross Profit	***$ 49.63***	***$ 35.19***	***$ 20.74***	***$ 6.30***	***$ (0.00)***	***$ (8.14)***	***$ (22.58)***

4.2: Sensitivity Analysis of Assumptions

Several variables that impact the budget should be further evaluated. Although the effect of calf ranch mortality is the primary focus here, sensitivity analyses of other relative variables are presented. Because each one percent decrease/increase in calf ranch mortality results in a net gain/loss of $14.45/head, the effect of mortality rates not presented in table 4.2 can be estimated.

Table 4.2 shows what breakeven price/percentage of each variable is for each percent change in mortality (calf ranch only) between 10% to 15%. A 10% mortality at the calf ranch, for example, would allow the feeder to pay $79.63/bull calf, ceteris paribus, and still break even. A 15% mortality at the calf ranch only allows for a 0.71% mortality rate at the feedyard before incurring a per-head net loss.

Mortality at the calf ranch may also have a carryover effect on the freight expense, depending on scale of the operation. In an operation shipping single loads of calves, a group with higher mortality would spread the cost over fewer calves. The per-head shipping cost would therefore increase.

Table 4.2: Breakeven Price of Variables at Relevant Mortality Rates at Calf Ranch

Variable	Basis	10%	11%	12%	13%	14%	15%
Calf Price	**$30.00**	$79.63	$65.19	$50.74	$36.30	$21.86	$7.42
Calf ranch per diem	**$2.15**	$2.48	$2.38	$2.29	$2.19	$2.10	$2.00
Live Price	**$1.10**	$1.13	$1.12	$1.11	$1.10	$1.09	$1.08
Mortality (feedyard)	**2.50%**	6.22%	5.17%	4.09%	2.99%	1.86%	0.71%
Feed	**$742.50**	$792.13	$777.69	$763.24	$748.80	$734.36	$719.92
Yardage	**$0.25**	$0.39	$0.35	$0.31	$0.27	$0.23	$0.19
Freight & Hauling	**$64.49**	$114.12	$99.68	$85.23	$70.79	$56.35	$41.91

CHAPTER V: CONCLUSION

Two primary incentives can be used to motivate dairy operations to prioritize calf health in the maternity barn. The most obvious is direct financial payments to dairies for improved total serum protein (TP) and birthweight, but less-direct benefits may also prove more effective.

Direct bonus payments to the dairy for each calf that tests above 5.6 g/dL TP, a bodyweight above 79 lbs., and has had the umbilicus treated with iodine tincture could be a good benchmark to begin with. Animals that do not meet the criteria would be discounted from the base price. While animal weight may be slow to improve over current levels, TP and treatment of the umbilicus are immediately actionable. Assuming an average 4,000-cow dairy sells 1,900 bull calves annually at $30 each, the annual revenue is $57,000. A $20.74 bonus per head increases the revenue to $96,406. That incentive is profitable for the cattle owner if mortality is reduced by >1.0% to 11%. A 2.0% reduction in mortality (to 10% mortality) would allow the cattle owner to pay the $20.74/head incentive plus add $28.89/head to his/her margin.

Another option for application of the profit margin may be in training for dairy maternity crews. While the direct bonus structure would most benefit dairies already performing, a different incentive program may be more beneficial. Instead of—or in addition to—providing a direct bonus structure, the cattle buyer could hire subject matter experts to train dairy maternity crews free of charge. Maternity crews may not be fully trained to identify dystocia, treat stressed calves, manage colostrum optimally, etc. This knowledge would also benefit heifers born that are typically valued at approximately $150/head in the current economic environment. A dairy's heifer replacement program typically makes up 15-20% of a dairy's annual cash expenditures (Abuelo, et al. 2019). Both parties have an opportunity to improve profitability with relatively little investment. If the same $15/head bonus above were used to train and provide consulting, the dairies supplying underperforming calves could identify and address weak points.

Ultimately, few options are as quickly adopted or effective at improving the cattle buyer's profitability as reducing mortality at the calf ranch. The data presented by Feedlot Health Management Services (FHMS) suggest that mortality can be reduced by sourcing calves from dairies that provide perinatal care including feeding high-quality colostrum and feeding close-up cows a ration that supports healthy birth weight.

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