Dairy Replacements – a Necessary, but Costly Investment

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Raising dairy replacements represent a substantial financial and time investment. Estimates place the cost to raise a dairy replacement from birth to 22 to 24 months of age at $1500 to over $2200. This represents 15 to 20% of the cost of producing milk, or to put it another way, over 17 lbs of milk each day of lactation for the first 2 years after calving goes to repay heifer rearing costs. Adequate, but not excessive, number of heifers are needed to replace cows that are culled. Raising more heifers than needed increases the total cost of a heifer rearing program and may result in the premature culling of productive and profitable cows. Both of these outcomes negatively impact the financial position of a dairy operation. The use of sexed semen has further increased the chances that more heifers are available than needed as herd replacements when maintaining cow-herd size. To best match heifer needs to those needed as replacements, one needs to estimate the number of heifers needed and then determine the best economical breeding program to rear an adequate, but not excessive, number of heifers.

Question 1: How many female calves are needed?

The first question one may ask is, how many heifer calves are needed yearly to replace culled cattle, while not raising more heifers than needed? This number is very much farm specific, but should be less than 1 heifer per cow, especially with the use of sexed semen. From 2015 to 2020, 122 participants in the New York Farm Business Management program (same farms throughout these years) reported the ratio of heifers to cows was 86% in 2015 and had dropped to 79% on average in 2020 with an average yearly cull rate of 35 to 36% for the milking herd. The top 25% of these Holstein herds for return on assets averaged 75% heifers per cow in 2020.

Table. Calculations for determining the number of heifers needed/remaining for differing milking herd cull rates.

		Cull Rate		
		35 %	39 %	43 %
Springers needed yearly to maintain herd size		35	39	43
	% change/loss*	# heifers needed (change in # heifers)		
# heifers/cows calving with female calf		47	53	57
# female calves at 24 hrs of age	5.7% stillbirths	45 (-2)	50 (-3)	54 (-3)
# heifers at 13 months of age	10.2% calf losses (< 13 months age)	40 (-5)	45(-5)	49 (-5)
# heifers which conceive	6.8% non-breeders	37 (-3)	42 (-3)	46 (-3)
# pregnant heifers (springers) to calve	6.4% pregnant heifers culled	35 (-3)	39 (-3)	43 (-3)

* % change/losses based on actual heifer data from 50 US Holstein herds by Drs. Overton and Dhuyvetter (2020, JDS, pg 3828). Actual numbers needed may vary based on your actual herd demographics.

Many factors impact the number of calves that must be retained and subsequently need to calve

Hypothetical Scenario for Herd of 100-Total Dairy Cows

Scenario assumes 39 heifers and 54 cows calve in a year for a total of 93 calvings per year, cows and heifers are springers (8.5-9 months pregnant) thus early embryonic losses are not taken into consideration. Stillbirths (do not survive > 24 hours of life) are taken into account in the calculations.

Virgin Heifers: 39 heifers calve to replace culled cows (cull rate = 39%)

60% (23 heifers) settled to sexed semen (90% result in females being born) resulting in 21 female fetuses/calves (born before accounting for stillbirths)

Remaining 40% (16 heifers) settled to conventional semen with 48% expected as females = 8 female fetuses/calves

Total = 29 female fetus/calves (21 from sexed semen + 8 from Conventional semen)

After accounting for stillborns = **27 female calves** alive at 24 hrs of age (5.7% stillbirths or 2 calves)

Cow Herd: Assume at least 54 cows are retained and calve within a year- 13.5 mo CI). This number of cows may be an underestimation if culled cows calve within the year.

Option 1: All 54 cows settled to conventional semen (48% expected females)
- Total = 26 female dairy calves born
- After accounting for stillbirths = **24 females** alive at 24 hrs of age

Option 2: 30% (16 cows) settled to sexed semen remaining 70% (38 cows) settled to conventional semen
- Female calves from sexed semen (90% female) = 14 female calves,
- Female calves from 38 cows settled to conventional semen (48% females) = 18 heifers
- Total = 32 female calves before accounting for stillbirths
- After accounting for stillbirths = **30 female** dairy calves alive at 24 hrs

Option 3: 30% (16 cows) settled to sexed semen, 40% (22 cows) settled to conventional semen, and remaining 30% (16 cows) settled to beef semen
- Female dairy calves from sexed semen (90% female) = 14 female calves,
- Female calves from 22 cows settled to conventional semen (48% females) = 11 heifers
- Beef crosses- 16 dairy x beef calves- 8 female, 8 male
- Total = 25 female dairy calves
- After accounting for stillbirths = **24 female dairy calves** alive at 24 hrs of age

Total number of females available for rearing after accounting for estimated stillbirths

Option 1: Heifers: 60% sexed semen, 40% conventional dairy semen; cows: conventional dairy semen = **51 female dairy calves at 24 hrs of age** (~32 male dairy calves)

Option 2: Heifers: 60% sexed, 40% conventional dairy semen; cows: 30% sexed, 70% conventional dairy semen = **57 female dairy calves at 24 hrs of age** (~28 male dairy calves)

Option 3: Heifers: 60% dairy sexed, 40% conventional dairy semen; cows: 30% dairy sexed, 40% conventional dairy semen, 30% beef semen = **51 female dairy calves at 24 hrs of age** (12 dairy males, 15 male/female dairy x beef crosses)

2 years later to replace cows culled from the herd. A herd's cull rate as well as success within the heifer rearing program impact the number of female calves needed. Heifer losses throughout the rearing period, voluntary-selective culling of heifers, and reproductive success impact the number of calves that must start in the heifer rearing program in order to have sufficient numbers to replace culled cows and maintain herd size. The challenge is: these factors are not easily predicted to a tee, can change year-to-year, and a few, but not excessive, number of heifers may be needed to account for necessary changes in culling of cows or losses of heifers.

Using a dairy's information, one can estimate the number of newborn heifers needed in order for a sufficient number of springers to be available to replace the estimated number of culled cows 2 years from now. The amount of risk one wants to undertake determines the number of extra calves that are needed. This approach was taken by Drs. Overton and Dhuyvetter and is summarized in the table. These scientists summarized records from 50 US Holstein herds to determine losses or increased numbers of heifers needed at different points in a heifer rearing program. Using these data, the scientists determined that for a 100-cow herd with an annual cull rate of 39%, 50 newborn heifers surviving post-24 hours of life would need to start in the heifer rearing system each year and calve into the herd by 24 months of age. This number of calves accounted for death losses during the first two years of life, reproductive failures, and a small amount of voluntary culling, but not losses within the first 24 hours of life, known as stillborn calves. When these scientists took into account heifers born as stillborns, an additional 3 heifer-calf pregnancies were needed (53 heifer calves). If calf losses in the first year of life where to decrease to 5% versus 10% used by the scenario, the total number of calves needed would drop by 2.5 heifers yearly or only 48 newborn heifers (if accounting for stillborns- 51 females born) would have to start in the rearing program. The reverse would also be true, if calf losses increased from 10 to 15%, 2.5 more heifers or a total of 53 newborns (56 calves born if accounting for stillborns) would be needed.

Question 2: How many female calves are born as a result from your breeding program?

The use of sexed semen in combination with conventional dairy semen does change the numbers of female calves expected. The hypothetical scenario (see box) illustrates the thought process necessary for determining the number of potential female calves born, surviving to 24 hours of age (not stillborn), and needing to be raised for replacements. In this scenario (please note assumptions in calculations), option 1 (sexed semen on heifers and conventional semen for the cow herd) result in 51 dairy heifers or 1 more heifer than needed (50 heifers needed at 24 hrs of age). Option 2 (sexed semen used in both heifers and cows) resulted in 57 heifers entering the heifer program or 7 more than needed to maintain herd size with a "cow" cull rate of 39%.

Many herds now are using beef semen in addition to sexed and conventional dairy semen to fine-tune the number of dairy replacement heifers born. Option 3 (sexed dairy semen, conventional dairy semen, and beef semen) potentially results in 51 dairy heifers or 1 more than needed. Determining the number of pregnancies needed from sexed and conventional dairy semen versus beef semen can be a mathematical challenge depending on the time frame selected for this calculation. Early embryo losses in the first 2 months of gestation are quite high (~ 30-45%, Whitbank and others), but are lower (~2%) after 60 days in gestation. Thus, calculations related to number of calves expected are easier when completed after the cows/heifers are post-60 to 90 days confirmed pregnant.