



# USING GENOMIC SELECTION AS A RISK MANAGEMENT TOOL

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# Project Goals

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Identify profitability differences in heifers chosen with and without genomic selection



Determine return on investment associated with genomic selection



Determine reduction in financial risk using genomic selection



Model manure load reduction with cattle chosen with genomic selection

# Project Timeline

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## Year 1

- Genomic selection on ~200 heifers across 6 dairies
- Gathered pedigree information
- Collected farm goals and mating/culling criteria
- Ranked heifers
- Conducted genomic education & developed web site
- Collected performance records

## Year 2

- Collected economic and performance data
- Conducted genomic education & web materials
- Return on investment calculations began
- Financial feasibility on commercial herds examined

## Year 3

- Complete 1<sup>st</sup> lactation data collection
- Complete financial analysis
- Conduct financial/genomic education
- Discuss results with each herd
- Complete environmental impact modeling

# Next Steps

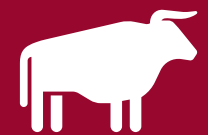
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Evaluate variations in specific traits across the study population



Perform environmental efficiencies analysis



Scientific and extension publications on study data and results

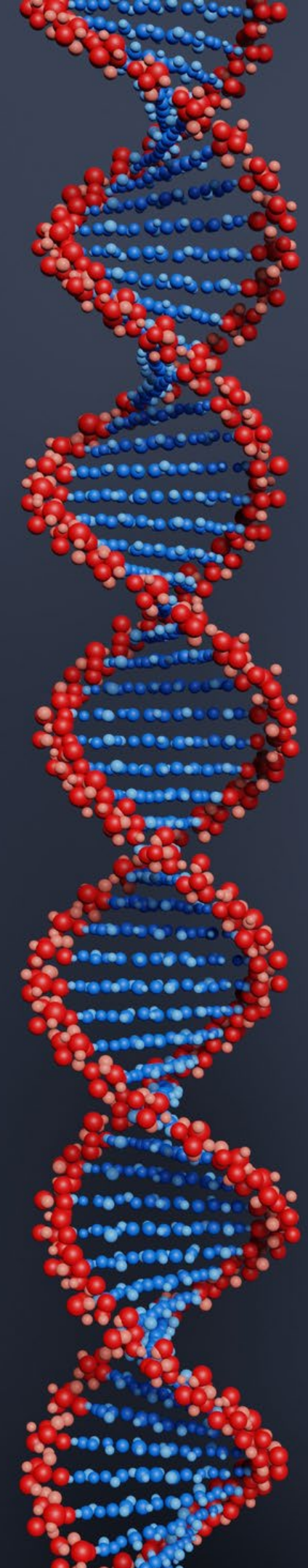


# Traditional Selection Criteria

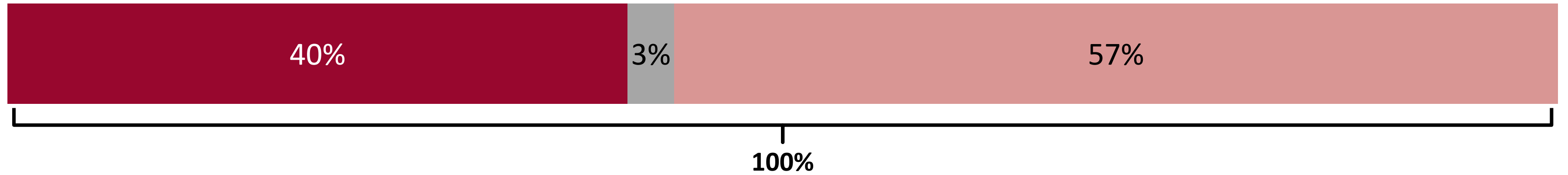
1. NM\$ - Parent average & sire values
2. Eliminate offspring from purchased herd of cattle
3. Examine for conformation criteria
  - Size & structural correctness
  - Other physical limitations

# Genomic Selection Criteria

1. NM\$ - Heifer's genomic values
2. Eliminate offspring from purchased herd of cattle
  - High ranking individuals kept, but preference to homebred heifers
3. Examine for conformation criteria
  - Size & structural correctness
  - Other physical limitations



# NM\$ Breakdown



■ Production ■ Conformation ■ Health & Efficiency

## Production

- 22% Fat
- 17% Protein
- <1% Milk

## Conformation

- 3% Udder Composite
- <1% Foot & Leg Composite

## Health & Efficiency

- 15% Productive Life
- -12.4% RFI
- -9.4% Body Weight Composite
- 5% DPR
- 4% each: Cow Livability
- 3% each: Calving Ability & SCC
- 1% each: Health Index, Early First Calving, CCR, Heifer Livability
- <1% Heifer Conception Rate

# Sire PTA vs. Heifer PTA

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Sire PTAs used to predict performance will estimate all progeny the same

Predictions from sire PTAs overestimate the individual's potential

Individual heifer PTAs most accurately predict future performance



# Study Breakdown: Initial Population

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**Total  
Sampled:**

**1,200**

**Total  
Removed:**

**70**

**Total  
Followed:**

**1,130**



# Study Breakdown: Initial Population

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**Total  
Sampled:**

**280**

**Total  
Removed:**

**21**

**Total  
Followed:**

**259**

# NM\$ Changes

Dairy C

## Ranking by Sire NM\$

	Animals	Min.	Max.	Avg.
Top 25%	98	621	669	625
Bottom 25%	103	227	447	403

## Ranking by Heifer NM\$

	Animals	Min.	Max.	Avg.
Top 25%	65			435
Bottom 25%	65			84

38% predicted to perform poorly

23% predicted to perform well

# NM\$ Changes

Entire Study

## Ranking by Sire NM\$

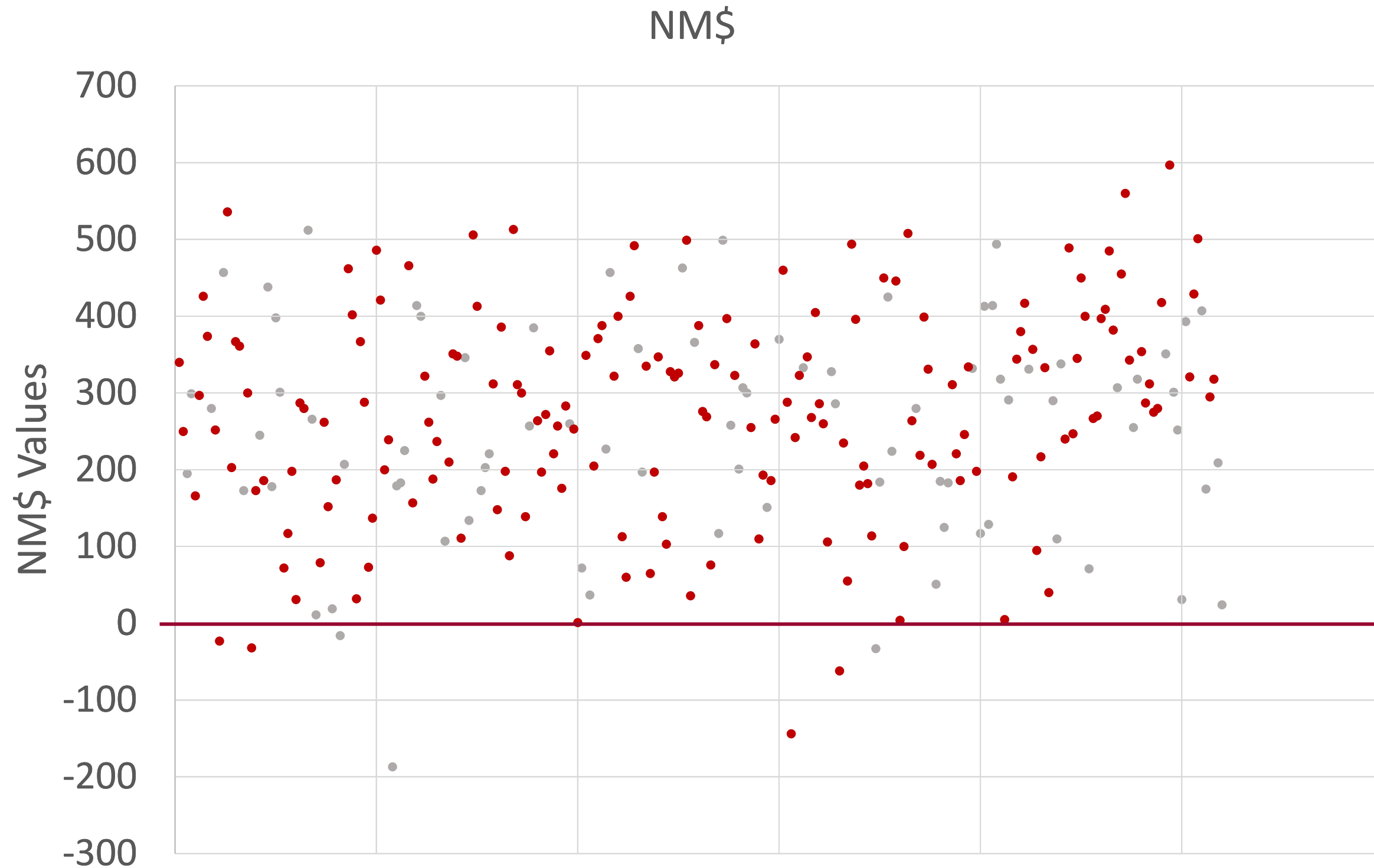
	Animals	Min.	Max.	Avg.
<b>Top 25%</b>	323	681	841	725
<b>Bottom 25%</b>	291	-809	555	455

## Ranking by Heifer NM\$

	Animals	Min.	Max.	Avg.
<b>Top 25%</b>	284	519	924	60
<b>Bottom 25%</b>	282	-187	315	

7% predicted to perform as a top individual

# Trait Distribution: NM\$



Initial Population Size: 259

Avg. NM\$: 266

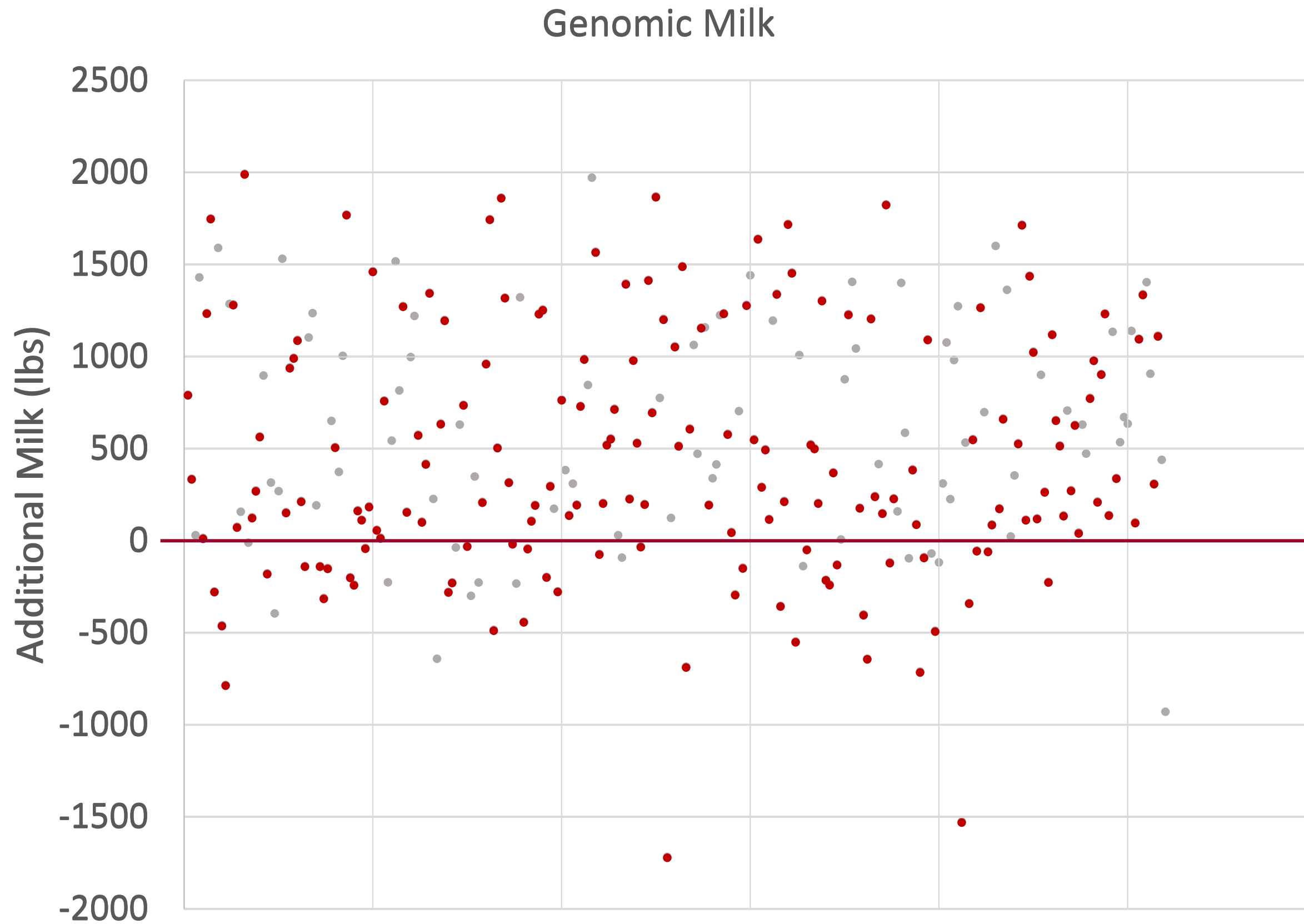
Ranged from -187 to 597

Remaining Population Size: 173

Avg. NM\$: 274

Ranged from -144 to 597

# Trait Distribution: Milk



Total Population Size: 259

Avg. Milk: 511

Ranged from -1,720 to 1,990

Remaining Population Size: 173

Avg. Milk: 458

Ranged from -1,720 to 1,990

# Animals Throughout the Study

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## Heifer Data

<b>Animals Sold:</b>	<b>27</b>
<b>Animals Died:</b>	<b>4</b>
<b>Total Entering 1st Lactation:</b>	<b>228</b>

88% calved into 1st lactation

## Cow Data

<b>Animals Sold:</b>	<b>45</b>
<b>Animals Died:</b>	<b>9</b>
<b>Completed 1st Lactation:</b>	<b>149</b>
<b>Confirmed Pregnant:</b>	<b>24</b>
<b>DNB/Still Milking:</b>	<b>1</b>

65% of those who freshened completed 1st lactation

58% of the heifers completed the study

# Animals Throughout the Study

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## Heifer Data

<b>Animals Sold:</b>	<b>92</b>
<b>Animals Died:</b>	<b>18</b>
<b>Total Entering 1st Lactation:</b>	<b>991</b>

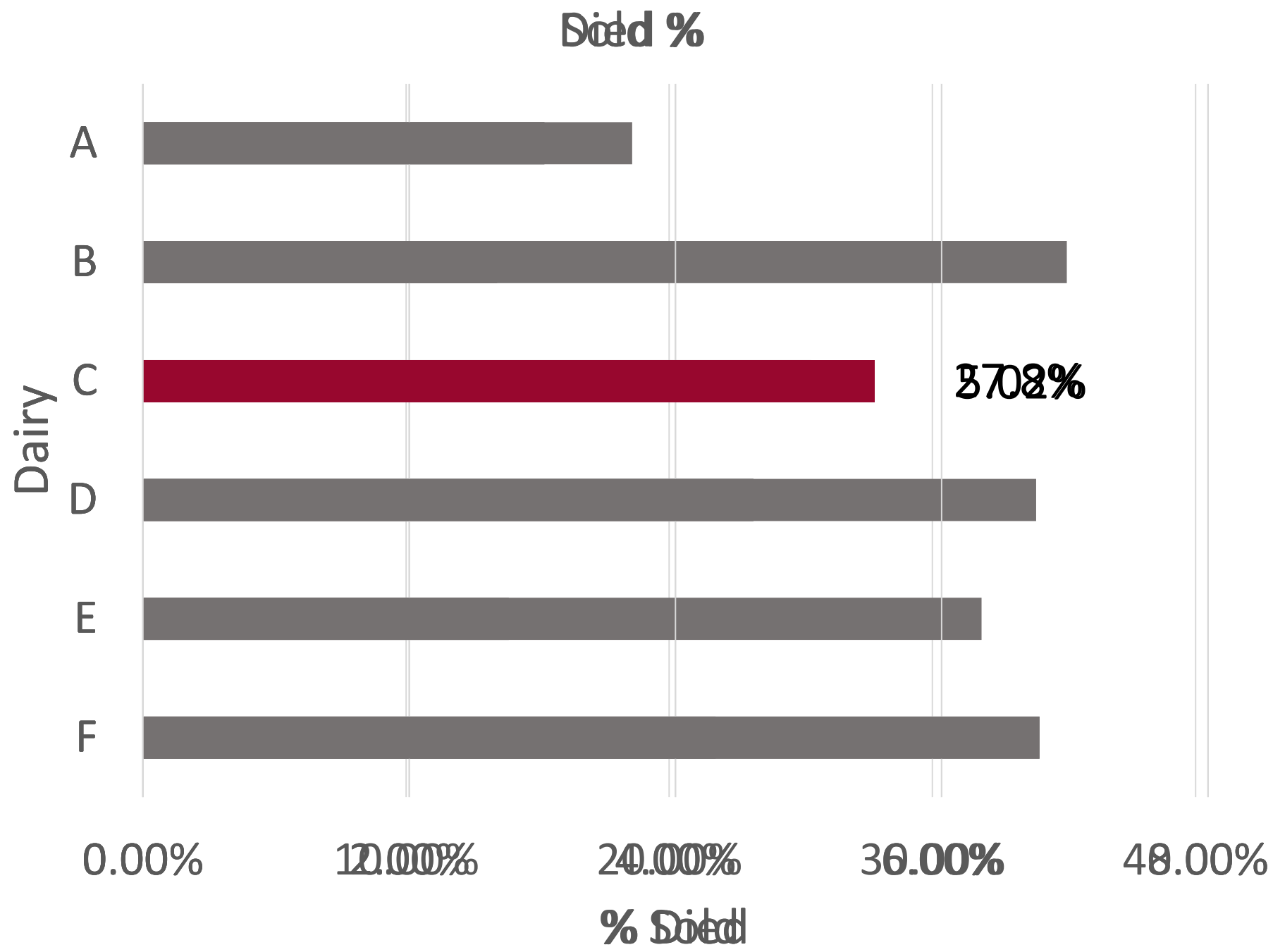
88% calved into 1st lactation

## Cow Data

<b>Animals Sold:</b>	<b>220</b>
<b>Animals Died:</b>	<b>29</b>
<b>Completed 1st Lactation:</b>	<b>659</b>
<b>Confirmed Pregnant:</b>	<b>71</b>
<b>DNB/Still Milking:</b>	<b>11</b>

66% of those who freshened completed 1st lactation

58% of the heifers completed the study



Proportion of  
**Culled/ Died**  
**Animals**

**Study Average: 4.13%**



# Reproductive Metrics

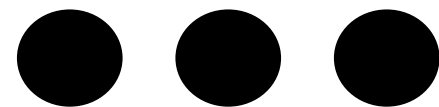
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## Heifer Times Bred

	Minimum	Maximum	Average
Dairy C	1	5	1.53
Study Average	1	6	1.71

## 1st Lactation Times Bred

	Minimum	Maximum	Average
Dairy C	1	6	2.39
Study Average	1	7	2.20



# Production Metrics

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## Total Milk

	Minimum	Maximum	Average
Dairy C	18,840	38,650	26,598
Study Average	11,980	39,708	24,258

## Total Fat

	Minimum	Maximum	Average
Dairy C	720	1,507	1,058
Study Average	495	1,894	967

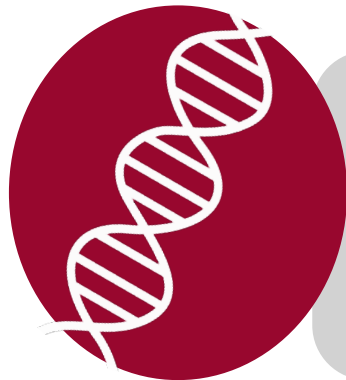
## Total Protein

	Minimum	Maximum	Average
Dairy C	570	1,149	806
Study Average	387	1,388	774

# Comparing Actual & Predicted Performance



Genomic predictions estimate individual performance over an industry average or "base value"



Predicted values were corrected by 80% to reflect production differences against mature cattle

Milk Production Averages (lbs)			
	Actual Production	Predicted Production Corrected	Predicted Production Uncorrected
Dairy C	26,598	22,777	28,471
Study Average	24,258	22,799	28,499

**Dairy C**  
Actual vs. Corrected Prediction:  
**+3,821 lbs**

**Dairy C**  
Actual vs. Uncorrected Prediction:  
**-1,874 lbs**

**Study**  
Actual vs. Corrected Prediction:  
**+1,459 lbs**

**Study**  
Actual vs. Uncorrected Prediction:  
**-4,241 lbs**

# Comparing Actual & Predicted Performance



Genomic predictions estimate individual performance over an industry average or "base value"



Predicted values were corrected by 80% to reflect production differences against mature cattle

## Milk Revenue Averages

	Actual Revenue	Predicted Revenue Corrected	Predicted Revenue Uncorrected
<b>Dairy C</b>	\$5,785.02	\$4,954.00	\$6,192.51
<b>Study Average</b>	\$5,271.21	\$4,958.07	\$6,198.39

**Dairy C**  
Actual vs. Corrected Prediction:

+\$831.02

**Dairy C**  
Actual vs. Uncorrected Prediction:

-\$407.48

**Study**  
Actual vs. Corrected Prediction:

+\$313.14

**Study**  
Actual vs. Uncorrected Prediction:

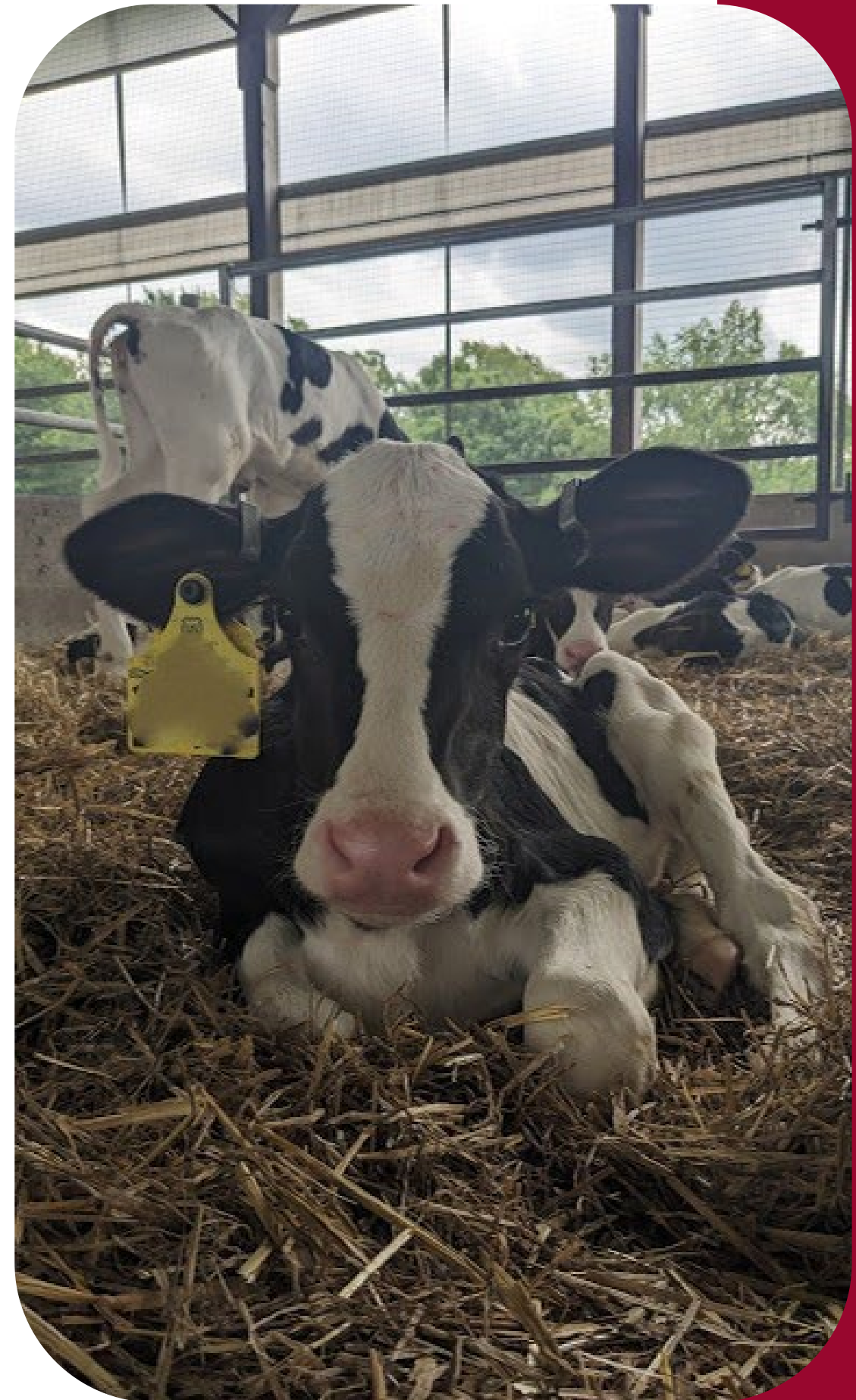
-\$927.18

# Return on Investment

Incomes were based on milk revenue calculations, as shown previously

Expenses included the costs of breeding and any recorded disease treatment/event and genomic testing

Revenue was determined by taking the difference between the income and expenses



# Return on Investment Results

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## Dairy C

### Income:

Minimum: \$4,097.70  
Maximum: \$8,406.38  
**Average: \$5,785.02**

### Expenses:

Minimum: \$163.86  
Maximum: \$1,827.41  
**Average: \$499.61**

### Revenue:

Minimum: \$3,620.14  
Maximum: \$7,468.19  
**Average: \$5,285.51**

## Entire Study

### Income:

Minimum: \$2,605.65  
Maximum: \$8,636.49  
**Average: \$5,276.07**

### Expenses:

Minimum: \$102.93  
Maximum: \$2,844.22  
**Average: \$480.43**

### Revenue:

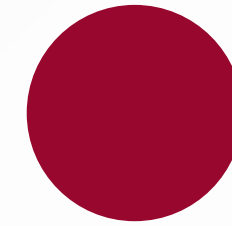
Minimum: \$1,829.48  
Maximum: \$8,000.50  
**Average: \$4,795.64**

# Quartile Comparison

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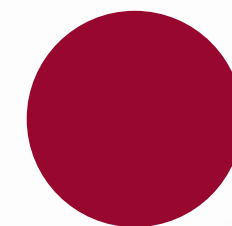
## Ranked by NM\$

**Top  
25%**



**\$5,543.68**

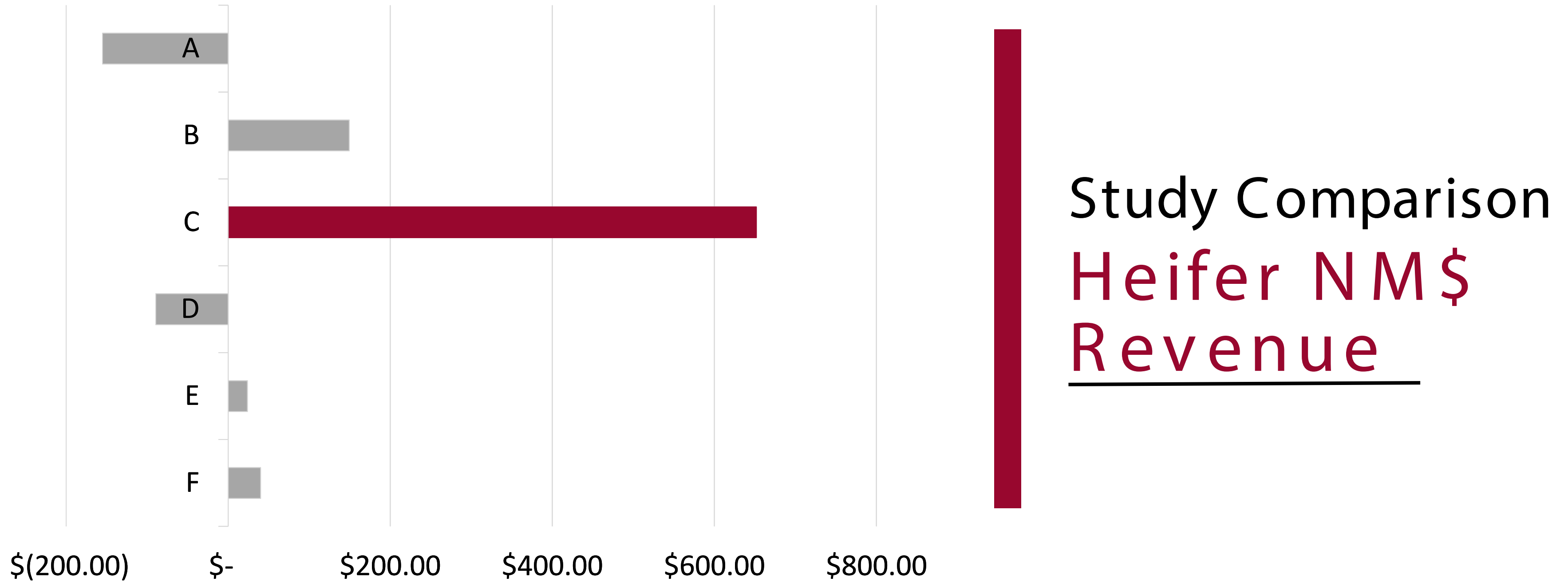
**Bottom  
25%**



**\$4,891.77**

**\$651.90 Difference  
Per Head**

# Heifer Genomic NM\$

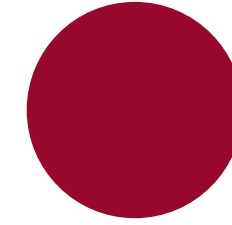


Study Comparison  
Heifer NM\$  
Revenue

Study Average:  
\$103.41

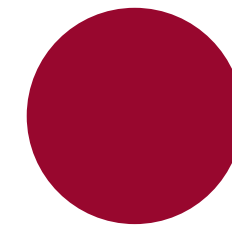
Quartile  
Comparison  
-  
Ranked by  
Genomic  
Milk

Top  
25%



**\$5,879.91**

Bottom  
25%

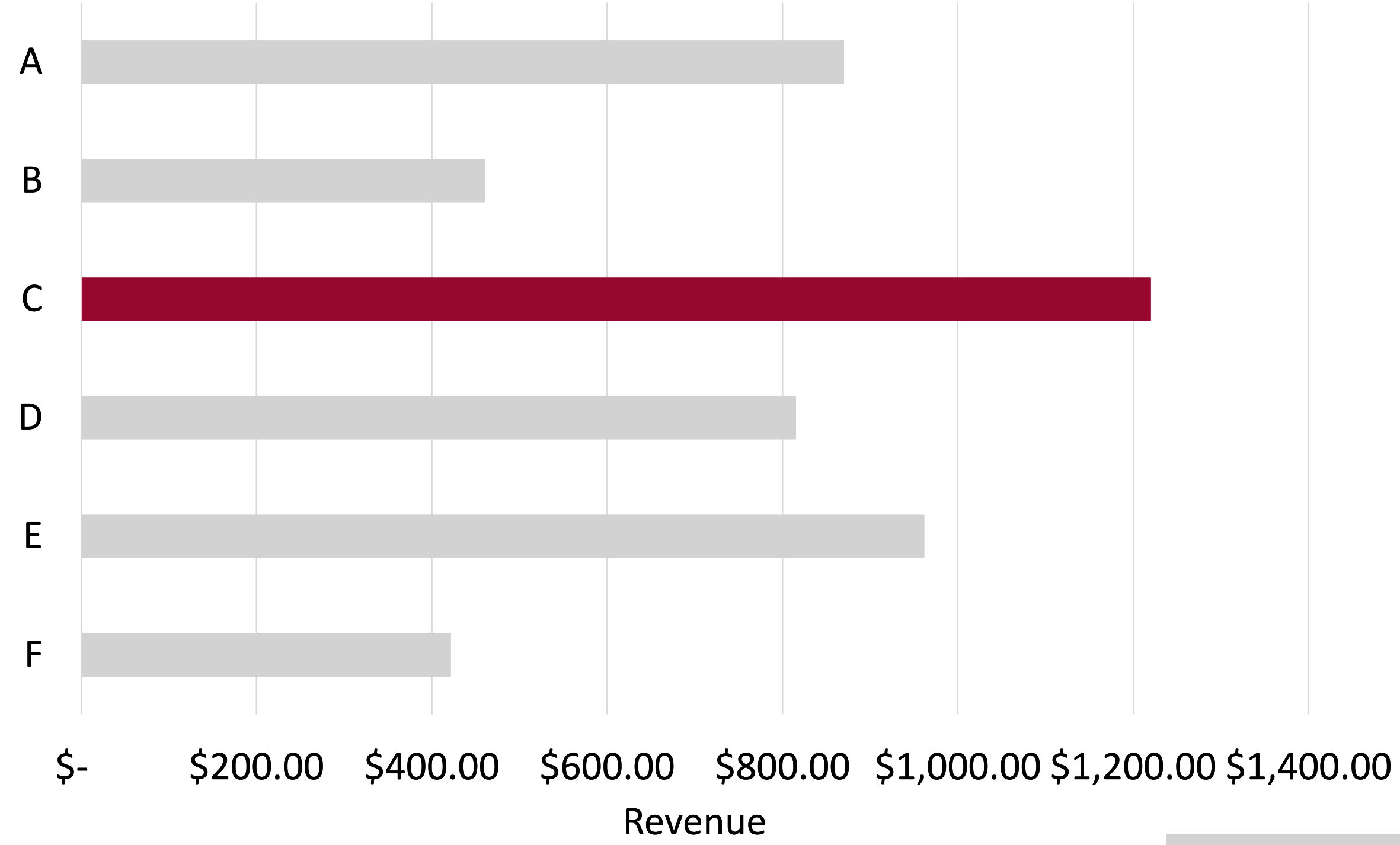


**\$4,660.44**

**\$1,219.47 Difference  
Per Head**



# Heifer Genomic Milk



Study Comparison  
**Heifer Genomic Milk**

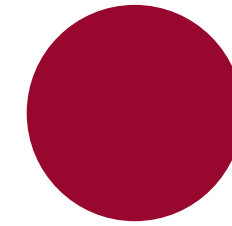
**Study Average:  
\$790.89**

# Quartile Comparison

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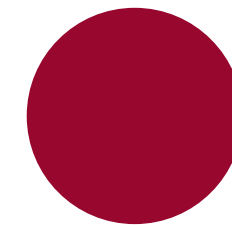
## Ranked by Sire NM\$

**Top  
25%**



**\$5,737.21**

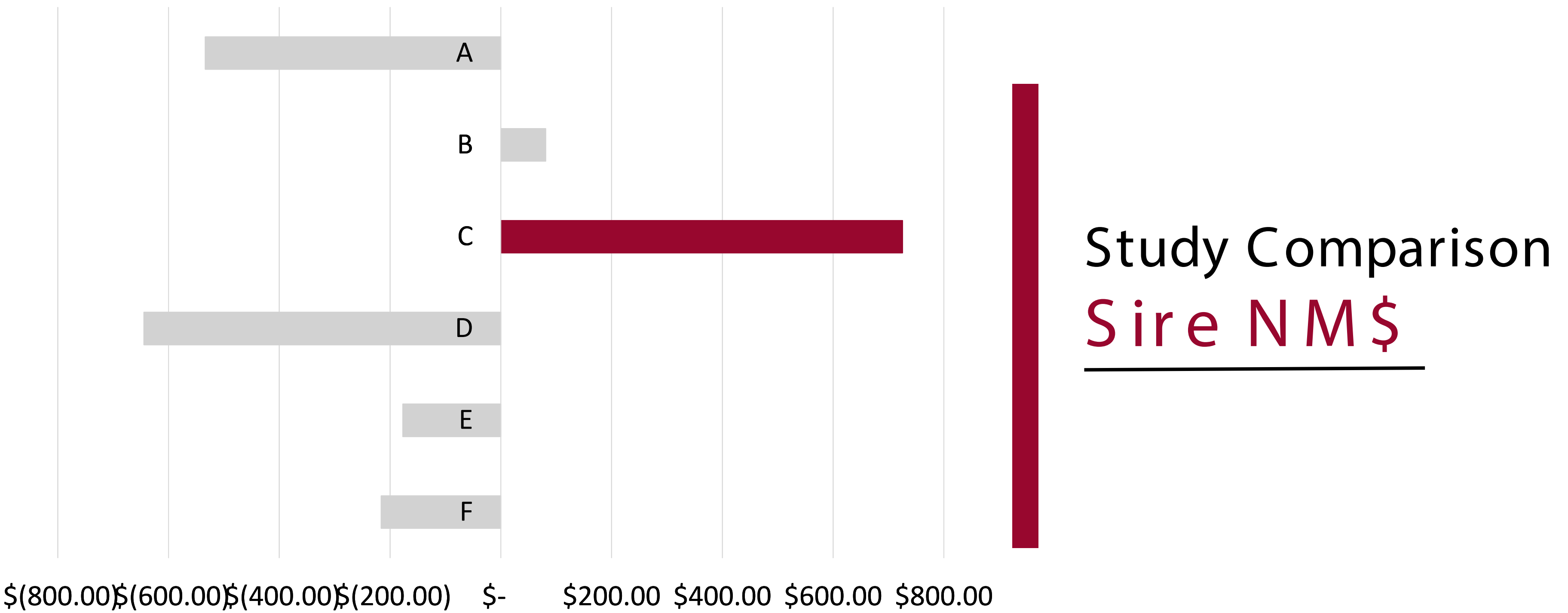
**Bottom  
25%**



**\$5,011.85**

**\$725.36 Difference  
Per Head**

### Sire PTA NM\$



Study Comparison  
**Sire NM\$**

**Study Average:  
-\$127.49**

\$(800.00) \$(600.00) \$(400.00) \$(200.00) \$- \$200.00 \$400.00 \$600.00 \$800.00

Revenue

# NM\$ Changes

Entire Study

## Individuals Who Were Sold/Died - NM\$

	<b>Animals</b>	<b>Min.</b>	<b>Max.</b>	<b>Avg.</b>
<b>Sire PTA</b>	361	170	841	611
<b>Genomic</b>	361	-187	924	395*

## Individuals Who Were Kept - NM\$

	<b>Animals</b>	<b>Min.</b>	<b>Max.</b>	<b>Avg.</b>
<b>Sire PTA</b>	720	-809	808	613
<b>Genomic</b>	720	-144	860	418*

\*P < 0.05

# NM\$ Changes

Entire Study

## Individuals Who Were Sold - NM\$

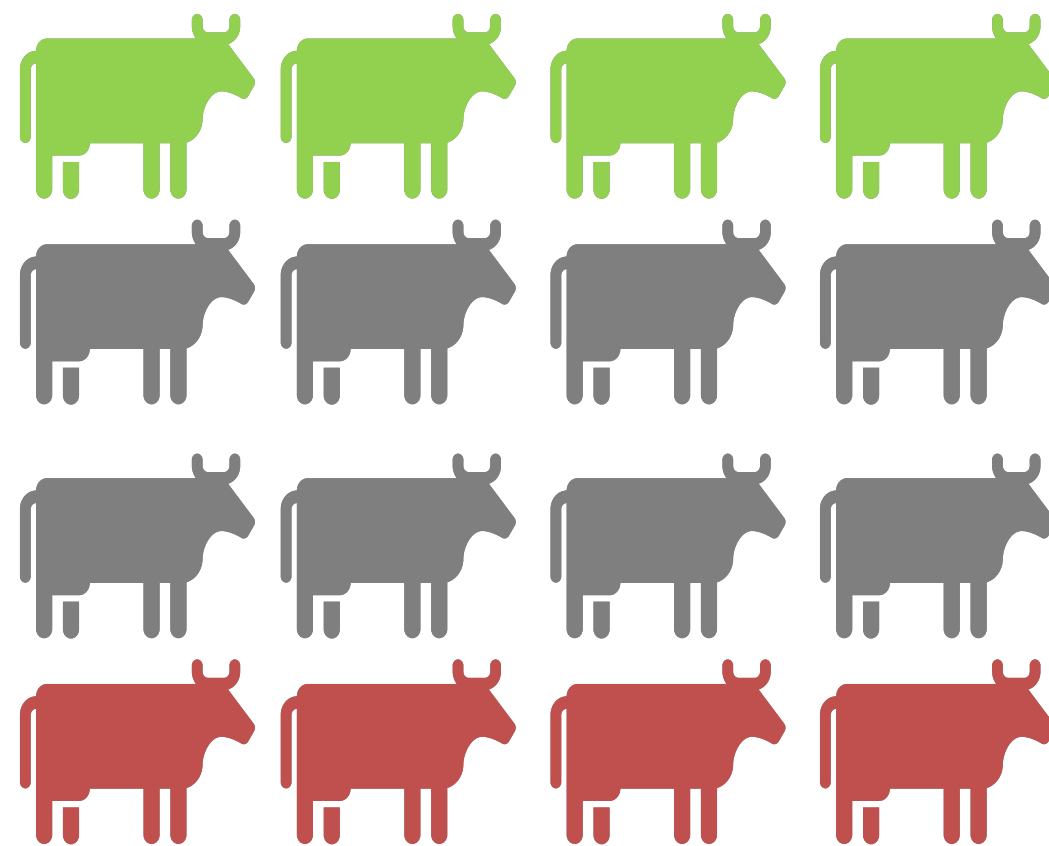
	<b>Animals</b>	<b>Min.</b>	<b>Max.</b>	<b>Avg.</b>
<b>Sire PTA</b>	314	170	841	610
<b>Genomic</b>	314	-187	924	391

## Individuals Who Died - NM\$

	<b>Animals</b>	<b>Min.</b>	<b>Max.</b>	<b>Avg.</b>
<b>Sire PTA</b>	47	170	789	617
<b>Genomic</b>	47	31	845	425

# Genomics & Risk Management

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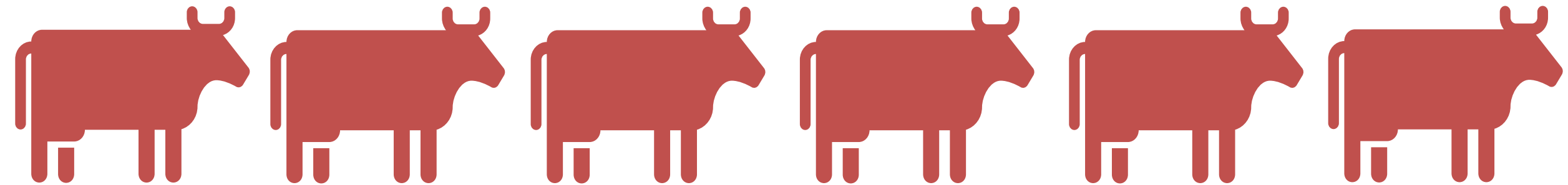
~\$1,200 difference  
between top and bottom  
quartile individuals

In a herd of 100 cows, the  
top 25% would make an  
additional ~\$30,000

This is the same as ~6 of the  
bottom quartile individual's  
average revenue

# Genomics & Risk Management

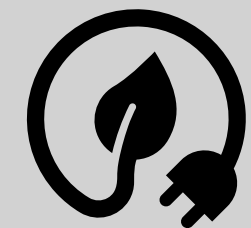
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Maintaining the same revenue, you would have 6 maintenance costs reduced (~\$28,000)



Six fewer cows would decrease the amount of manure and methane being produced



This would reduce the volume of resources consumed, such as water, energy, and labor

# Acknowledgements

## Washington Dairies

- Coulee Flats Dairy
- Cow Palace Dairy
- Lenssen Dairy
- Royal Dairy

## Idaho Dairies

- Beranna Dairy
- Kasper Dairy

## Website & Information



Sustainable Agriculture  
Research & Education

Project # SW21-925







# THANK YOU

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Are there any questions?

