Controlling the Cost of Beef Production through Improving Feed Efficiency

Rod Hill\textsuperscript{1*}, Cassie M. Welch\textsuperscript{1}, J.D. Wulfhorst\textsuperscript{2}, Stephanie Kane\textsuperscript{2}, Larry D. Keenan\textsuperscript{3} and Jason K. Ahola\textsuperscript{4}

\textsuperscript{1}Department of Animal and Veterinary Science, and
\textsuperscript{2}Social Sciences Research Unit, University of Idaho
\textsuperscript{3}Red Angus Association of America and
\textsuperscript{4}Department of Animal Science, Colorado State University
Introduction

• Who cares about Feed Efficiency?

• What about Feed Efficiency in the feedlot?

• What about Cowherd efficiency?
Part 1

A time of increasing costs and cost volatility
Cow-Calf Producer Inventory & Returns

New era of higher feed costs (source: USDA)
Cow-Calf Producer Feed-Associated Costs

New era of higher feed costs

average 62%

(source: USDA-ERS)
U.S. average annual prices for alfalfa and other hay

(source: USDA-NASS Monthly Agricultural Prices summarized by LMIC)
U.S. average annual price for corn

(source: USDA-NASS Monthly Agricultural Prices summarized by LMIC)
Cow-calf profit?

- Standardized performance analysis (SPA) – IA and IL – 225 producers
- Feed cost largest of 12 factors
- 52 – 57% of variation in profit

Miller et al., 2001
DISCUSSION

• What do you control?
  • Price paid for product?
  • Investment in feed and other inputs?
• What percentage of total cost of beef production is carried in Cow-calf sector?
Part 2

Different Measures of Feed Efficiency

Which is best?
Measuring Efficiency

Gross Feed efficiency (feed-to-gain ratio)

\[ \frac{\text{feed consumed}}{\text{weight gain}} = \text{gross feed efficiency} \]

Limitations

Highly correlated with growth rate

Confounded with: maturity pattern, size, appetite, composition of gain, heifer/cow size

Favors genetically-larger cattle
New Measure of Efficiency

Residual Feed Intake (RFI)

Actual vs. predicted feed intake ($h^2 = 0.16 - 0.43$)

(prediction is based on: gain and body weight)

Independent of growth and mature patterns

Interpretation:

+ RFI: Intake higher than requirements

– RFI: Eat less and produce same weight gain

Herd et al., 2003; Johnson et al., 2003; Richardson et al., 2001
Residual Feed Intake (RFI)

Baker et al., 2006
Residual Feed Intake (RFI)

Circled points = 3.2 lbs/d ADG with 40.7 vs. 56.1 lbs/d feed intake

RFI value = difference between the line and each data point

Baker et al., 2006
Value of RFI

• Consume less feed but weigh the same at harvest vs. high RFI progeny

• Reduction of feed costs w/o negatively affecting growth, reproduction, carcass, or meat quality

• Environmental outcomes
  • reduced impact on rangelands
  • reduction of methane, manure, nitrogen
Contributions of biological mechanisms to variation in residual feed intake as determined from experiments on divergently selected cattle (from Richardson and Herd, 2004).
What About Correlations with Other Traits?

- Production and reproduction?
  - Birth weight
  - Fertility

- Pasture grazing?
  - Heifers and steers
  - Mature cows
    - (impact on rangelands)
    - (major contributor to cost of production)

- End product?
  - Carcass yield
  - Palatability
DISCUSSION

- Why does a negative value indicate superior performance?
  - -ve RFI is superior to +ve RFI

- What is the problem with using feed conversion ratio?
Part 3

What do we know about producer understanding and adoption of RFI?
Project Title:

Feed Efficiency Research and Outreach for the Beef Industry
Design Summary

**Bulls: High vs Low ME EPD**

- Three cohorts
  - Approximately 300 calves

- Steer progeny followed through slaughter product quality

- Physiological indicators (plasma IGF-1)
Equipment

**Advantages:**
- Continuous monitoring
- Decreased labor needs
- Self-operating

**Disadvantages:**
- Costly to install
- Not 100% at bunk
New Physiological Tests

Goal: Find livestock superior for RFI

Traditional test

70-day period, individual intake

Alternative tests

Gene markers
Physiological tests

Need extensive RFI testing to validate marker technologies.
New Physiological Tests

Surgery – Biceps femoris biopsy for gene expression studies
Factors affecting beef cattle producer perspectives on feed efficiency

J.D. Wulfhorst J.K. Ahola, S.L. Kane, L.D. Keenan and R.A. Hill

Overview

• Conduct social assessment
  – Willingness & barriers to adoption of RFI
  – National scope – but focus groups – Idaho & RAAA

• Will address some key responses
Approach

• Survey to 1,888 producers
  – Stratified random sample
    • Idaho Cattle Association (n = 488)
    • Red Angus Association of America (RAAA) members (n = 2208 / 700)
    • RAAA bull buyers (n = 5,325 / 700)
  – 35 Questions
Survey Response Rates / Categories

• 49.9% (902) - 57%, 50%, and 45%.- responded
  – 59% commercial cow-calf producers
  – 41% seedstock or combined operations

• Mean (± SD) respondent age / experience
  – seedstock producers, 52.6 ± 0.8 yr, with 25.3 ± 0.9 yr of experience
  – commercial producers, 56.1 ± 0.7 yr, with 30.7 ± 0.8 yr experience

• Regions based on NCBA (pooled)
Survey Regions

- **WEST**: 28.0%
- **NORTH**: 50.6%
- **SOUTH**: 21.4%
Respondents’ – Cattle Operation description

- 77% - British breeds exclusively
- 19% - Combination of British and Continental breeds
# Characteristics of beef cattle operations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Commercial Producers</th>
<th>Seedstock Producers</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cows</td>
<td>223.4</td>
<td>205.8</td>
</tr>
<tr>
<td>No. of bulls</td>
<td>12.8</td>
<td>23.2</td>
</tr>
<tr>
<td>Calves sold at weaning, %</td>
<td>49.8</td>
<td>38.2</td>
</tr>
<tr>
<td>Calves sold at yearling, %</td>
<td>34.3</td>
<td>40.1</td>
</tr>
<tr>
<td>Calves retained through harvest, %</td>
<td>16.4</td>
<td>21.2</td>
</tr>
<tr>
<td>No. of cows marketed/yr</td>
<td>25.9</td>
<td>21.0</td>
</tr>
<tr>
<td>No. of calves marketed/yr</td>
<td>209.7</td>
<td>147.5</td>
</tr>
<tr>
<td>No. of bulls purchased/yr</td>
<td>2.6</td>
<td>1.8</td>
</tr>
<tr>
<td>Price per bull, $/animal</td>
<td>2,325.6</td>
<td>3,097.1</td>
</tr>
</tbody>
</table>

*Source:* Social survey of commercial and seedstock cattle producers, 2008, administered by University of Idaho, Social Science Research Unit (SSRU).
## Sources of having heard about RFI

<table>
<thead>
<tr>
<th>Category</th>
<th>No (%)</th>
<th>Yes (%)</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed association magazine</td>
<td>46.3</td>
<td>53.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Scientific journal</td>
<td>90.5</td>
<td>9.5</td>
<td>1.8</td>
</tr>
<tr>
<td>Weekly livestock newspaper</td>
<td>69.3</td>
<td>30.7</td>
<td>3.0</td>
</tr>
<tr>
<td>University Extension</td>
<td>72.3</td>
<td>27.7</td>
<td>2.8</td>
</tr>
<tr>
<td>Beef Improvement Federation</td>
<td>88.3</td>
<td>11.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Veterinarian</td>
<td>94.3</td>
<td>5.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Websites</td>
<td>95.8</td>
<td>4.2</td>
<td>1.3</td>
</tr>
<tr>
<td>From a neighbor, friend, or colleague</td>
<td>83.7</td>
<td>16.2</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Source: Social survey of commercial and seedstock cattle producers, 2008, administered by University of Idaho, Social Science Research Unit (SSRU).

Note: Producer responses to the question “Where did you hear about RFI? Please mark ALL that apply.”
## Level of knowledge about the use of RFI as a measure of genetic value

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>No knowledge</td>
<td>23.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Limited knowledge</td>
<td>60.8</td>
<td>3.2</td>
</tr>
<tr>
<td>Knowledgeable</td>
<td>14.3</td>
<td>2.0</td>
</tr>
<tr>
<td>Very knowledgeable</td>
<td>1.3</td>
<td>1.3</td>
</tr>
</tbody>
</table>

*Source:* Social survey of commercial and seedstock cattle producers, 2008, administered by University of Idaho, Social Science Research Unit (SSRU).

*Note:* Producer responses to the question “How knowledgeable are you with the use of RFI as a measure of genetic value?”
Perceived willingness-to-pay to have bulls evaluated for RFI (seedstock producers only)

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 more / head</td>
<td>28.1</td>
<td>2.6</td>
</tr>
<tr>
<td>$1 – 100 more / head</td>
<td>51.1</td>
<td>2.7</td>
</tr>
<tr>
<td>$101 – 200 more / head</td>
<td>13.1</td>
<td>1.9</td>
</tr>
<tr>
<td>$201 – 300 more / head</td>
<td>3.9</td>
<td>1.1</td>
</tr>
<tr>
<td>$301 – 450 more / head</td>
<td>1.2</td>
<td>0.7</td>
</tr>
<tr>
<td>More than $450 more / head</td>
<td>2.5</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Source: Social survey of commercial and seedstock cattle producers, 2008, administered by University of Idaho, Social Science Research Unit (SSRU).

Note: Seedstock producer responses to the question “If the equipment to collect individual feed intake data were available to you, how much more would you be willing to pay on a per-head basis to have your bulls evaluated for RFI?”.
Perception of whether bulls are worth more if evaluated for RFI and found to be more efficient

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>15.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Yes</td>
<td>75.9</td>
<td>1.7</td>
</tr>
<tr>
<td>Don’t know</td>
<td>8.2</td>
<td>1.1</td>
</tr>
</tbody>
</table>

*Source:* Social survey of commercial and seedstock cattle producers, 2011, administered by University of Idaho, Social Science Research Unit (SSRU).

*Note:* Producer responses to the question “Do you think bulls (and/or their semen) that were evaluated for RFI and found to be more efficient should be worth more?”
Perception of demand among bull customers for feed efficiency or RFI data

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>No demand</td>
<td>3.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Little demand</td>
<td>12.9</td>
<td>1.3</td>
</tr>
<tr>
<td>Moderate demand</td>
<td>38.8</td>
<td>1.9</td>
</tr>
<tr>
<td>Great deal of demand</td>
<td>41.2</td>
<td>1.9</td>
</tr>
<tr>
<td>Don’t know</td>
<td>3.9</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Source: Social survey of commercial and seedstock cattle producers, 2011, administered by University of Idaho, Social Science Research Unit (SSRU).

Note: Seedstock producer responses to the question “How much demand is there among your bull customers for feed efficiency or RFI data?”
Perceived willingness-to-pay among buyers for bulls evaluated for feed efficiency

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% (no additional value)</td>
<td>17.9</td>
<td>2.0</td>
</tr>
<tr>
<td>1-10%</td>
<td>45.0</td>
<td>2.6</td>
</tr>
<tr>
<td>11-25%</td>
<td>19.5</td>
<td>2.0</td>
</tr>
<tr>
<td>26-50%</td>
<td>3.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Greater than 50%</td>
<td>1.1</td>
<td>0.6</td>
</tr>
<tr>
<td>Don’t know</td>
<td>12.6</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Source: Social survey of commercial and seedstock cattle producers, 2011, administered by University of Idaho, Social Science Research Unit (SSRU).

Note: Seedstock producer responses to the question “How much more are your buyers willing to pay for bulls evaluated for feed efficiency?”
DISCUSSION

• What is the cost to RFI-test a bull?

• Should an RFI-tested bull be worth more?

• Should we continue to research RFI?
Acknowledgements

This work was supported by National Research Initiative Competitive Grant no. 2008-55206-18812 from the USDA Cooperative State Research, Education, and Extension Service & by the National Science Foundation and Idaho EPSCoR under award number EPS 0447689.
Questions / Comments?
Project Key-points:

- Studies on the progeny of Red Angus bulls divergent for Maintenance Energy EPD.

- Begin to characterize these Red Angus bulls for Residual Feed Intake

- Study the relationships between Maintenance Energy EPD, RFI and other production traits

- Study the underlying physiological drivers of variation in RFI.
Project Objectives (1-2):

• Research Objective 1: Evaluate and quantify the relationships between RFI and product quality in progeny of Red Angus sires divergent for maintenance energy EPD.

• Research Objective 2: Evaluate and quantify the relationships between RFI and finishing phase FE in the steer progeny of Red Angus sires divergent for maintenance energy EPD.
Project Objectives (3-5):

• Research Objective 3: Determine the relationship between plasma IGF-1 at weaning and RFI in progeny of Red Angus sires divergent for maintenance energy EPD.

• Research Objective 4: Determine the relationship between ME EPD and RFI EPD in Red Angus bulls divergent for ME EPD.

• Research Objective 5: Establish baseline and follow-up measures of producer perceptions about the perceived unique benefits and/or costs associated with RFI, as well as the efficacy of outreach programs in conveying this information.
Project Outreach Objectives:

Outreach Objective 1: Develop outreach materials using research results that are suitable for delivery to all levels within the industry via several methods including field days and symposia, train-the-trainer events, popular press and scientific journal articles, final reports, and other outreach methods via partnerships with industry.

Outreach Objective 2: Disseminate information to producers via internet-based outreach, primarily through the recently-created Beef Cattle Community of Practice with eXtension.
# Design Summary

## Bulls: High vs Low ME EPD

<table>
<thead>
<tr>
<th></th>
<th>CED</th>
<th>BW</th>
<th>WW</th>
<th>YW</th>
<th>Milk</th>
<th>TM</th>
<th>ME</th>
<th>MEacc</th>
<th>HPG</th>
<th>CET</th>
<th>ST</th>
<th>Marb</th>
<th>REA</th>
<th>Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>7.00</td>
<td>-0.13</td>
<td>32.50</td>
<td>61.83</td>
<td>16.33</td>
<td>32.67</td>
<td><strong>14.00</strong></td>
<td>55.67</td>
<td>11.67</td>
<td>8.17</td>
<td>12.17</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Max</td>
<td>10.00</td>
<td>1.90</td>
<td>39.00</td>
<td>68.00</td>
<td>25.00</td>
<td>41.00</td>
<td>20.00</td>
<td>60.00</td>
<td>13.00</td>
<td>13.00</td>
<td>17.00</td>
<td>0.14</td>
<td>0.30</td>
<td>0.02</td>
</tr>
<tr>
<td>Min</td>
<td>2.00</td>
<td>-1.50</td>
<td>26.00</td>
<td>54.00</td>
<td>9.00</td>
<td>26.00</td>
<td>12.00</td>
<td>51.00</td>
<td>9.00</td>
<td>2.00</td>
<td>5.00</td>
<td>-0.12</td>
<td>-0.27</td>
<td>-0.01</td>
</tr>
<tr>
<td>CV</td>
<td>0.50</td>
<td>-9.08</td>
<td>0.13</td>
<td>0.09</td>
<td>0.34</td>
<td>0.16</td>
<td>0.23</td>
<td>0.06</td>
<td>0.15</td>
<td>0.50</td>
<td>0.33</td>
<td>-</td>
<td>-9.86</td>
<td>2.10</td>
</tr>
<tr>
<td><strong>LOW</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>13.83</td>
<td>-3.73</td>
<td>28.33</td>
<td>55.00</td>
<td>16.00</td>
<td>30.33</td>
<td><strong>-8.83</strong></td>
<td>53.67</td>
<td>7.17</td>
<td>2.83</td>
<td>12.33</td>
<td>0.08</td>
<td>0.12</td>
<td>0.00</td>
</tr>
<tr>
<td>Max</td>
<td>19.00</td>
<td>1.60</td>
<td>37.00</td>
<td>62.00</td>
<td>29.00</td>
<td>46.00</td>
<td>-4.00</td>
<td>58.00</td>
<td>10.00</td>
<td>8.00</td>
<td>17.00</td>
<td>0.15</td>
<td>0.52</td>
<td>0.03</td>
</tr>
<tr>
<td>Min</td>
<td>2.00</td>
<td>-7.40</td>
<td>17.00</td>
<td>46.00</td>
<td>10.00</td>
<td>19.00</td>
<td>-13.00</td>
<td>49.00</td>
<td>5.00</td>
<td>-5.00</td>
<td>8.00</td>
<td>-0.03</td>
<td>-0.05</td>
<td>-0.04</td>
</tr>
<tr>
<td>CV</td>
<td>0.47</td>
<td>-0.89</td>
<td>0.28</td>
<td>0.13</td>
<td>0.50</td>
<td>0.34</td>
<td>-0.39</td>
<td>0.07</td>
<td>0.30</td>
<td>1.72</td>
<td>0.25</td>
<td>0.96</td>
<td>1.75</td>
<td>-</td>
</tr>
</tbody>
</table>
Equipment

- Calan Gates
- Personnel intensive
Results

Relationship between ADG and DMI of Red Angus-sired steers and heifers measured for RFI
Discussion

• Mean RFI value is 0.0
  – Range typical

• Correlations typical with other studies
  – Carcass & end-product traits not yet evaluated

• No relationship between RFI and ADG
  – RFI independent of growth rate
Discussion

• RFI correlated with DMI

• Measuring RFI – no sex differences detected

• Progeny RFI range is large
  – 35% variation in DMI for same growth rate
Summary and Next Steps

• Sire ME and progeny RFI
  – No formal conclusions
  – Data obtained from small population

• Data provide preliminary indications

• RFI and ME EPD relationship will become clearer

• A need to generate more data on mature cows