The Environmental and Economic Impact of Calving Rate Within U.S. Beef Production

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OBJECTIVE
To quantify the effects of calving rate within U.S. beef production upon environmental and economic sustainability metrics

INTRODUCTION
- The cow-calf industry is the foundation upon which U.S. beef industry productivity depends
- Industry concern currently exists regarding the declining size of the national herd, due to drought and external influences
- Long-term reductions in the national herd size may be disadvantageous to industry survival, yet previous research demonstrated that maintaining beef supply from a smaller total herd improves both environmental and economic sustainability through greater resource use efficiency
- Improved reproductive performance has long been cited as a mechanism to improve the economic viability of beef production, yet the impact of this productivity metric upon resource use and greenhouse gas (GHG) emissions has not yet been quantified

MATERIALS & METHODS
- A deterministic, environmental impact model based on the nutrition and metabolism of beef cattle (Capper, 2012) was used to quantify resource use and greenhouse gas (GHG) emissions from producing 363 kg hot-carcass weight beef
- Model system boundaries extended from manufacture of cropping inputs to animal arrival at the slaughterhouse door
- Beef production was modeled using characteristic U.S. production data, management practices and population dynamics; and included four animal sub-systems: cow-calf, stocker, feedlot plus inputs (calves and cull cows) from dairy production
- The impact of altering calving rate within the cow-calf sector was investigated at 5% intervals, with a U.S. baseline of 90% calving rate (NAHMS, 1991) compared to the ideal of 100%, and extending out to 40%, characteristic of very extensive systems
- A 60% calving rate (characteristic of extensive systems in South America and South Africa) was used as a comparison point
- Economic impact was calculated based on feed usage for beef production at national market prices

ACKNOWLEDGMENTS
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RESULTS

Table 1. Resource use, GHG emissions and economic impact per 363 kg hot-carcass weight beef at three different calving rates within U.S. beef production (percentage difference from ideal expressed in parentheses)

<table>
<thead>
<tr>
<th>Calving Rate (%)</th>
<th>100% (Ideal)</th>
<th>90% (U.S.)</th>
<th>60% (Global Extensive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total animals (supporting plus slaughter population)</td>
<td>2.35</td>
<td>2.51 (+6.8%)</td>
<td>3.38 (+43.8%)</td>
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<tr>
<td>Land use (ha)</td>
<td>2.36</td>
<td>2.55 (+8.1%)</td>
<td>3.61 (+53.0%)</td>
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<tr>
<td>Water use (liters)</td>
<td>508,242</td>
<td>534,742 (+5.2%)</td>
<td>681,712 (+34.1%)</td>
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<tr>
<td>Fossil fuels (MJ)</td>
<td>2,434</td>
<td>2,502 (+2.8%)</td>
<td>2,878 (+18.2%)</td>
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<tr>
<td>GHG emissions (kg CO2e)</td>
<td>5,458</td>
<td>5,837 (+6.9%)</td>
<td>7,943 (+45.5%)</td>
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<tr>
<td>Feed cost ($)</td>
<td>1,412</td>
<td>1,491 (+5.6%)</td>
<td>1,924 (+36.3%)</td>
</tr>
</tbody>
</table>

Figure 1. Impact of variation in calving rate on resource use (A: animals; B: land; C: water; D: fossil fuel energy), GHG emissions (E) and economic impact (F: feed cost) per 363 kg hot-carcass weight beef produced by the U.S. beef industry

CONCLUSIONS
- Opportunities clearly exist to reduce environmental and economic impact per unit of beef by improving calving rate, with the greatest returns per unit increase occurring at lower calving rates
- Further research should focus on quantifying the proportional contribution of other management practices, including calf mortality and weaning weight

REFERENCES