Leveraging new technologies and novel breeding strategies to sustainably grow global beef production

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Total cattle inventory is the smallest since 1958. However, beef production has doubled since then.
Brazil: available pasture and beef production per hectare

**Pasture Area (MI HA) X Productivity (@/HA)**

- **Pasture Area**
  - 1990: 165.0
  - 2016: 120.0

- **Productivity @/ha**
  - 1990: 0.70
  - 2016: 4.70

Source: Agroconsult/IBGE

Brazilian livestock overview and its contribution to the sustainable development, 2016

Profit From Genetic Progress
Beef production growth expected, especially in developing world.

Note: c.w.e. is carcass weight equivalent, r.t.c. is ready to cook equivalent.

Countries with the greatest share of additional meat production by meat type
2025 vs 2013-15

Beef production in developing countries will be 20% higher in 2025, with most growth in Argentina, Brazil, India and China.

Note: c.w.e. is carcass weight equivalent, r.t.c. is ready to cook equivalent.

Per capita meat consumption by country and region

Beef consumption in developing countries expected to increase 21%

Note: c.w.e. is carcass weight equivalent, r.t.c. is ready to cook equivalent.

Genetic programs around the world have made progress for traits related to beef production.

American Angus Association $B Genetic Trend

Nelore Genetic Trend for weight

Source: American Angus Association

Source: Celso Koetz Junior et al., 2017
Progress for economically relevant traits?

• Less progress for traits directly related to producer profitability

• Beef industry structure creates challenges to improving ERT, which is critical for ensuring sustainable growth

Table 1. Proposed economically relevant traits and their indicators.

<table>
<thead>
<tr>
<th>Economically Relevant Trait EPD</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sale Weight</td>
<td>265 d Weight</td>
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<tr>
<td></td>
<td>365 d Weight</td>
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<tr>
<td></td>
<td>Carcass Weight</td>
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<tr>
<td></td>
<td>Birth Weight</td>
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<tr>
<td></td>
<td>Fat Thickness</td>
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<tr>
<td></td>
<td>Cull Cow Weight</td>
</tr>
<tr>
<td>Probability of Calving Ease</td>
<td>Calving Ease Score</td>
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<tr>
<td></td>
<td>Birth Weight</td>
</tr>
<tr>
<td></td>
<td>Gestation Length</td>
</tr>
<tr>
<td>Cow Maintenance Feed Requirement</td>
<td>Mature Cow Weight</td>
</tr>
<tr>
<td></td>
<td>Cow Condition Score</td>
</tr>
<tr>
<td></td>
<td>Milk Production*</td>
</tr>
<tr>
<td></td>
<td>Gut Weight</td>
</tr>
<tr>
<td>Stayability (or LPL*)</td>
<td>Calving Records</td>
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<tr>
<td></td>
<td>Days to Calving</td>
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<tr>
<td></td>
<td>Calving Interval</td>
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<tr>
<td></td>
<td>Milk Production*</td>
</tr>
<tr>
<td>Heifer Pregnancy Rate</td>
<td>Pregnancy Observations</td>
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<tr>
<td></td>
<td>Sortal Circumference</td>
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<tr>
<td>Tenderness</td>
<td>Amount of Intramuscular Fat</td>
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<tr>
<td></td>
<td>Shear Force</td>
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<tr>
<td>Days to a Target Finish Fat Thickness</td>
<td>Backfat and Age at Slaughter</td>
</tr>
<tr>
<td>Days to a Target Weight Finish Endpoint</td>
<td>Weight and Age at Slaughter</td>
</tr>
<tr>
<td>Days to a Target Probability of Grading Finish Endpoint</td>
<td>Grade and Age at Slaughter</td>
</tr>
<tr>
<td>Doolity</td>
<td>Doolity Scores</td>
</tr>
</tbody>
</table>

*Indicators* means traits which are measured to provide information to produce the economically relevant trait EPD. This list contains just the most obvious indicators. It is likely that different situations will be able to use other indicators.

Economically Relevant Traits: A framework for the next generation of EPDs. Golden et al., 2000
The Global Roundtable for Sustainable Beef defines sustainable beef as a socially responsible, environmentally sound and economically viable product that prioritizes **Planet** (relevant principles: Natural Resources, Efficiency and Innovation, People and the Community); **People** (relevant principles: People and the Community and Food); **Animals** (relevant principle: Animal Health and Welfare); and **Progress** (relevant principles: Natural Resources, People and the Community, Animal Health and Welfare, Food, Efficiency and Innovation).

**Natural Resources**
The global beef value chain manages natural resources responsibly and enhances ecosystem health.

**People & The Community**
Global sustainable beef stakeholders protect and respect human rights, and recognize the critical roles that all participants within the beef value chain play in their community regarding culture, heritage, employment, land rights and health.

**Animal Health & Welfare**
Global sustainable beef producers and processors respect and manage animals to ensure their health and welfare.

**Food**
Global sustainable beef stakeholders ensure the safety and quality of beef products and utilize information-sharing systems that promote beef sustainability.

**Efficiency & Innovation**
Global Sustainable Beef Stakeholders encourage innovation, optimize production, reduce waste and add to economic viability.
The Global Roundtable for Sustainable Beef defines sustainable beef as a system that is environmentally responsible, economically viable and socially just. It prioritizes principles such as Natural Resources, People and the Community, Animals (relevance and welfare), Food and Efficiency and Innovation.

**Efficiency & Innovation**
Global Sustainable Beef Stakeholders encourage innovation, optimize production, reduce waste and add to economic viability.
The role of breeding companies in sustainable beef production

1. Make genetic improvement for traits directly related to profitability and simplify selection decisions

2. Effectively disseminate improvement

3. Provide tools and support to maximize realized improvement and value generation

Innovation is critical: use new technology to accelerate genetic gain
Genomics

Relationship based genomic selection starts

García-Ruiz et al. (2016)
Extending to sequence
Gene editing

Genome editing in livestock: Are we ready for a revolution in animal breeding industry?
Jinxue Ruan · Jie Xu · Ruby Yanru Chen-Tsai · Kui Li

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Potential of promotion of alleles by genome editing to improve quantitative traits in livestock breeding programs
Janez Jenko¹, Gregor Gorjanc¹, Matthew A Cleveland², Rajeev K Varshney³, C. Bruce A Whitelaw¹, John A Woolliams¹ and John M Hickey¹
#phenotypeisking

- Phenotyping underutilized in many breeding programs

- Novel phenotyping provides opportunity to improve ERT that have not been measured before
Artificial insemination & IVF/ET

Estimated percent beef cow AI in Brazil

2017: 11.7%
Example strategy to disseminate improved genetics for beef production

Maternal and terminal genetics may come from different countries, markets and/or breeds.
Optimal dissemination can lead to a product that is measurably better and demanded by the supply chain.

Virtual integration = Demand created for specific products based on price signals passed to farmers, even with multiple ownership changes.
Creating terminal genetics for Brazil

Distribution of Index values for sires used to create terminal beef from a Nelore cow

R$ 183,00
Realized impact of improved genetics for Brazil terminal system

- **Weight Gain**: +13%
- **Carcass Weight**: +6%
- **Feed Conversion**: -6%
- **Weaning Weight**: +4%
Creating beef from the dairy herd: a UK example

Maximising dairy farmers’ profitability through improved beef genetics

Delivering more value
Incremental £ value to the dairy farmer by sire (baseline = low indexing sire)

More milk from the herd

More calves to sell for beef

More £££ per calf sold

Sire 1: +37
Sire 2: +61
Sire 3: +77
Sire 4: +95
Sire 5: +101
Sire 6: +108
Sire 7: +114
Sire 8: +127
Sire 9: +141
Sire 10: +157

Profit From Genetic Progress
Summary

• Demand for beef continues to grow, especially in developing regions

• Many current breeding programs are not well suited to generate the improvements needed to sustainably grow beef production

• Key is to leverage new technologies for the efficient dissemination of improved genetics coupled with approaches to ensure farmers realize genetic potential
Thank you!

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