Role of Breeding in Addressing GHG Mitigation Opportunities.

Teagasc Signpost Farm Webinar.

29 April 2022
Overview of Talk.

• Genetics & GHG mitigation; what are current indexes/approaches delivering?
• Where are the “new” opportunities in the future?
  • Carbon sub-indexes.
  • Direct selection for methane.
  • Earlier finishing age.
  • New carbon farming models.
  • Genotyping the National cattle herd.
  • Dairy Beef Integration.
• Key decisions for dairy and beef farmers this Spring.
• Summary & discussion.
Current EBI => Profit + Sustainability.

• Current EBI Trends will deliver 658 KT of reduction in CO2e by 2030 (of 4.5-6.5 MT target).
Current Rep Index => Profit + Sustainability.

<table>
<thead>
<tr>
<th>Herd Average Trait</th>
<th>Source</th>
<th>SD</th>
<th>Btm 20%</th>
<th>Btm 21-40%</th>
<th>Average</th>
<th>Top 21-40%</th>
<th>Top 20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Replacement Index</td>
<td>ICBF/BDGP</td>
<td>€42</td>
<td>€63</td>
<td>€80</td>
<td>€96</td>
<td>€122</td>
<td></td>
</tr>
<tr>
<td>Cow Liveweight (All parities; kg)</td>
<td>BEEP</td>
<td>56.0</td>
<td>688.8</td>
<td>669.5</td>
<td>664.3</td>
<td>655.5</td>
<td>651.6</td>
</tr>
<tr>
<td>Calf 200 day Liveweight (kg)</td>
<td>BEEP</td>
<td>34.8</td>
<td>279.7</td>
<td>280.1</td>
<td>284.9</td>
<td>286.3</td>
<td>287</td>
</tr>
<tr>
<td>Weaning Efficiency (%)</td>
<td>BEEP</td>
<td>5.5</td>
<td>40.8</td>
<td>42.0</td>
<td>43.0</td>
<td>43.9</td>
<td>44.3</td>
</tr>
<tr>
<td>Calving Interval (days)</td>
<td>ICBF</td>
<td>28.7</td>
<td>399.1</td>
<td>394.2</td>
<td>389.8</td>
<td>384.6</td>
<td>387.7</td>
</tr>
<tr>
<td>Calves/cow/year</td>
<td>ICBF</td>
<td>0.12</td>
<td>0.85</td>
<td>0.88</td>
<td>0.89</td>
<td>0.91</td>
<td>0.91</td>
</tr>
<tr>
<td>Profit/livestock unit</td>
<td>Teagasc</td>
<td>€207</td>
<td>€219</td>
<td>€238</td>
<td>€244</td>
<td>€262</td>
<td></td>
</tr>
<tr>
<td>Carbon Footprint (GHG/kg)</td>
<td>Bord Bia</td>
<td>1.82</td>
<td>13.16</td>
<td>12.97</td>
<td>12.82</td>
<td>12.42</td>
<td>11.91</td>
</tr>
</tbody>
</table>

David Kelly, PhD, Teagasc.

Validation of a beef cattle maternal breeding objective based on a cross-sectional analysis of large national cattle database

Alan J. Twomey, Andrew R. Cromie, Noinir McHugh, and Donagh P. Berry

1Animal and Grassland Research and Innovation Centre, Teagasc, Moorepark, Fermoy, Co., Cork, Ireland. 2Irish Cattle Breeding Federation, Highfield House, Barndon, Co., Cork, Ireland.

Corresponding author: alan.twomey@teagasc.ie

Current Rep Index trends will deliver 181 KT of reduction in CO2e by 2030 of 4.5-6.5 MT target.
Potential of Breeding to reduce GHG emissions

<table>
<thead>
<tr>
<th>T1. Options for increasing genetic gain in the dairy herd for GHG traits.</th>
<th>Fix Output</th>
<th>Stable herd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current EBI Trends</td>
<td>658</td>
<td>69</td>
</tr>
<tr>
<td>+ Carbon Sub Index (i.e., additional weighting on female fertility traits)</td>
<td>96</td>
<td>108</td>
</tr>
<tr>
<td>++ Methane Yield Traits</td>
<td>67</td>
<td>77</td>
</tr>
<tr>
<td>+++ Methane Yield Traits @ 30% weighting in Index</td>
<td>85</td>
<td>207</td>
</tr>
<tr>
<td>++++ Methane Yield Traits @ 30% weighting in Index &amp; Top 40% threshholds</td>
<td>97</td>
<td>101</td>
</tr>
<tr>
<td>Sub-total</td>
<td>1003</td>
<td>562</td>
</tr>
<tr>
<td>+ DNA calf reg (20% increase in accuracy =&gt; additional genetic gain)</td>
<td>200.6</td>
<td>112.4</td>
</tr>
<tr>
<td>Total</td>
<td>1203.6</td>
<td>674.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T2. Options for increasing genetic gain in the beef herd for GHG traits.</th>
<th>Fix Output</th>
<th>Stable herd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Euro-Star Trends</td>
<td>181</td>
<td>71</td>
</tr>
<tr>
<td>+ Methane Yield Traits</td>
<td>74</td>
<td>78</td>
</tr>
<tr>
<td>+++ Methane Yield Traits @ 30% weighting in Index</td>
<td>91</td>
<td>110</td>
</tr>
<tr>
<td>Sub-total</td>
<td>346</td>
<td>259</td>
</tr>
<tr>
<td>+ DNA calf reg (20% increase in accuracy =&gt; additional genetic gain)</td>
<td>69.2</td>
<td>51.8</td>
</tr>
<tr>
<td>Total</td>
<td>415.2</td>
<td>310.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T3. Overall (Dairy + Beef)</th>
<th>Fix Output</th>
<th>Stable herd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1618.8</td>
<td>985.2</td>
</tr>
</tbody>
</table>

- Under fixed output scenario (as per MACC), breeding had potential to mitigate ~1.6T CO2e over 10 year period => enabling.
- But goal-posts have now shifted => away from cap on output & instead “stable” herd => direct.
- Breeding now has potential to mitigate ~1mT CO2e.
- Conditional on implementation of various “enhancements” to our breeding indexes & strategies.
i. EBI & New Carbon Sub Index.

- Current EBI is delivering \(-19\) Kg reduction in CO2e/lactation (0.3% of total).
- Benefits of cumulative gains; after 10 years => 3% reduction.
- Can we increase this rate gain further?

Opportunity to double the gain (-39 kg CO2e/lact) but will require us shift 33% of index onto a new “carbon sub-index” => expect 0.6% gain/year.

- Relative gain in “profit” from EBI will be reduced by 15%, with gain in milk sub-index reduced and gain on fertility increased.
- Expect significant re-ranking (r=0.82), with animals of higher genetic merit for female fertility benefiting most.
ii. EBI & Breeding for lower methane animals.

- To date ~1000 animal’s have measurements on growth, DMI & CH4/day from Tully (largest dataset globally).
  - Progeny of Beef & Dairy AI sires from the G€N€ IR€LAND breeding program.
  - Funded through a range of research programs including DAFM GreenFeed, Master & by ICBF/DAFM directly.
  - Initial results now available => Average CH4/day = 250 g/day & clear evidence of differences across genders, systems & breeds, including within breed.
Initial Results – What are we seeing?

- Early evidence of new genetic variation => dairy AI sires that are higher (+10 g/day) & lower (-20 g/day) in terms of genetic merit for CH4/day. Similar results observed for beef breeds.

- Goal of having genomic predictions for methane traits from Tully in 2022.

- Opportunity to apply within our beef indexes.

- What about dairy?
  - Differences between cows at grass and dairy steers finished indoors?

- New program to collect CO2e data directly on dairy farms in 2022+, as part of the G€N€ IR€LAND breeding program.
  - Better alignment of research partners & projects into an overall National strategy.

- Potential to increase CO2e mitigation to 1%/year through breeding.
(iii) Age at Slaughter – High Level Trends.

- Average age at slaughter has reduced by ~45 days since 2010, with additional gains in carcass weight => benefits of selecting for growth rate in our indexes. Gains in last 12 months of particular note.
- Evident across all key groups of animals AND across system, e.g., suckler beef steers.
- Can we go faster and help achieve our GHG targets?
Promoting an Earlier Finishing Age.

- Critical that any initiative is supported by science, and simply doesn’t result in farmers incurring more costs (i.e., feed & fertilizer).

- First step is to;
  - Establish a “science-based” approach to optimizing finishing age and then,
  - Utilize this approach in future programs/initiatives aimed at promoting a younger age at slaughter, e.g., benchmark reports, RDP initiatives, pricing bonuses etc.

- Defining key “systems” a critical part of this overall strategy.

- Teagasc research => Grass + Concentrates and slaughtered at 24 months had the same gross emissions (4 T CO2e/animal) as a “Grass Only” system where the animal was slaughtered at 28 months. *Dr Paul Crosson, Teagasc National Beef Conference, Nov 2020*
**Key requirement - Science-based approach.**

- New Animal carbon footprint developed in conjunction with Teagasc & AbacusBio => CO2e in the animal’s lifetime.
- Based on building a growth profile for all animals and then overlaying feed & fertilizer requirements + other GHG => lifetime CO2e.
- Allows comparison of animals across genders, breeds, systems etc.
- Available via a new benchmark report at the time of slaughter, via meat processor, web tools etc.
  - Work being piloted with ABP & then rolled nationally.
- Further developments in pipeline, e.g., integrating growth profile data into Teagasc/Bord Bia Carbon Footprint Model.
- Can we utilize new metric to help promote an earlier age at finish?

<table>
<thead>
<tr>
<th>Gender * System</th>
<th>Count</th>
<th>%</th>
<th>Cwt (kg)</th>
<th>Age (M)</th>
<th>CO2e (kg/animal)</th>
<th>Carbon FP (CO2e/kgCwt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEERS</td>
<td>663,455</td>
<td>53%</td>
<td>350</td>
<td>26.8</td>
<td>4,668</td>
<td>13.2</td>
</tr>
<tr>
<td>- No clear system</td>
<td>65,045</td>
<td>5%</td>
<td>381</td>
<td>35.1</td>
<td>6,699</td>
<td>17.6</td>
</tr>
<tr>
<td>- Spr born &amp; slaug off grass 3rd summer</td>
<td>277,984</td>
<td>22%</td>
<td>360</td>
<td>28.8</td>
<td>5,077</td>
<td>14.1</td>
</tr>
<tr>
<td>- Spr born &amp; slaug out of house @ 2 yrs</td>
<td>199,783</td>
<td>16%</td>
<td>337</td>
<td>23.9</td>
<td>3,997</td>
<td>11.9</td>
</tr>
<tr>
<td>- Aut born &amp; slaug @ ~2yrs</td>
<td>70,782</td>
<td>6%</td>
<td>358</td>
<td>24.9</td>
<td>4,342</td>
<td>12.1</td>
</tr>
<tr>
<td>- Spr born &amp; slaug off grass 2nd summer</td>
<td>45,994</td>
<td>4%</td>
<td>295</td>
<td>19.5</td>
<td>2,948</td>
<td>9.9</td>
</tr>
<tr>
<td>- Slaug young age</td>
<td>3,867</td>
<td>0%</td>
<td>284</td>
<td>15.0</td>
<td>2,242</td>
<td>7.9</td>
</tr>
<tr>
<td>HEIFERS</td>
<td>471,246</td>
<td>37%</td>
<td>308</td>
<td>25.3</td>
<td>4,101</td>
<td>13.1</td>
</tr>
<tr>
<td>- No clear system</td>
<td>42,833</td>
<td>3%</td>
<td>332</td>
<td>35.3</td>
<td>6,249</td>
<td>18.5</td>
</tr>
<tr>
<td>- Spr born &amp; slaug off grass 3rd summer</td>
<td>134,530</td>
<td>11%</td>
<td>320</td>
<td>28.2</td>
<td>4,642</td>
<td>14.5</td>
</tr>
<tr>
<td>- Spr born &amp; slaug out of house @ 2 yrs</td>
<td>146,027</td>
<td>12%</td>
<td>306</td>
<td>23.7</td>
<td>3,769</td>
<td>12.3</td>
</tr>
<tr>
<td>- Aut born &amp; slaug @ ~2yrs</td>
<td>62,572</td>
<td>5%</td>
<td>320</td>
<td>24.2</td>
<td>3,970</td>
<td>12.3</td>
</tr>
<tr>
<td>- Spr born &amp; slaug off grass 2nd summer</td>
<td>80,843</td>
<td>6%</td>
<td>272</td>
<td>19.8</td>
<td>2,877</td>
<td>10.5</td>
</tr>
<tr>
<td>- Slaug young age</td>
<td>4,441</td>
<td>0%</td>
<td>252</td>
<td>14.8</td>
<td>2,075</td>
<td>8.3</td>
</tr>
<tr>
<td>YOUNG BULLS</td>
<td>124,949</td>
<td>10%</td>
<td>369</td>
<td>19.0</td>
<td>3,544</td>
<td>9.6</td>
</tr>
<tr>
<td>&gt; 20 months</td>
<td>35,784</td>
<td>3%</td>
<td>378</td>
<td>22.6</td>
<td>4,283</td>
<td>11.2</td>
</tr>
<tr>
<td>16-20 months</td>
<td>51,035</td>
<td>4%</td>
<td>362</td>
<td>19.4</td>
<td>3,524</td>
<td>9.8</td>
</tr>
<tr>
<td>&lt; 20 months</td>
<td>38,130</td>
<td>3%</td>
<td>371</td>
<td>15.2</td>
<td>2,875</td>
<td>7.8</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1,259,650</td>
<td>100%</td>
<td>336</td>
<td>25.5</td>
<td>4,345</td>
<td>12.8</td>
</tr>
</tbody>
</table>
What are the potential reductions in CO2e.

### T1. Strategies to promote earlier age at finish in Steers.

<table>
<thead>
<tr>
<th>Description of Strategy</th>
<th>Current animals</th>
<th>Future animals</th>
<th>Level of Uptake</th>
<th>CO2e Diff (T/animal)</th>
<th>Change (KT CO2e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Move animals from &quot;no system&quot; (note: one off gain)</td>
<td>65</td>
<td>15</td>
<td>50</td>
<td>-2.0</td>
<td>-100</td>
</tr>
<tr>
<td>2. Move from finishing off grass in 3rd summer to finishing of grass in 2nd summer</td>
<td>278</td>
<td>178</td>
<td>100</td>
<td>-2.1</td>
<td>-210</td>
</tr>
<tr>
<td>3. Achieve a 1 month reduction in age at finish through greater technical performance</td>
<td>663</td>
<td>663</td>
<td>500</td>
<td>-0.21</td>
<td>-105</td>
</tr>
<tr>
<td><strong>Total Reduction</strong></td>
<td><strong>663</strong></td>
<td><strong>663</strong></td>
<td><strong>500</strong></td>
<td><strong>-0.21</strong></td>
<td><strong>-105</strong></td>
</tr>
</tbody>
</table>

- Combined potential to reduce CO2e by -415 KT in Steers.
- An additional 350 KT is achievable via similar strategies in heifers and young bulls => 800 KT CO2e reduction. Gains are repeatable, e.g., every 100k animals moved to slaughtering off grass in second summer => 200KT.
- What are the enabling factors to help make this happen?

- Opportunity to develop strategies that will promote an earlier age at finish;
  - Move 50k animals from “no system”
  - Move 100k animals from finishing off grass in 3rd summer to finishing off grass in 2nd summer.
  - Encourage 500k animals (i.e., 75% of current steer cattle kill) to achieve a 1 month reduction in age at slaughter within their current defined system.
Earlier Finishing Age - Enabling Factors.

- **New genetic evaluations for age at slaughter.**
  - Current “growth traits” are a good start, but opportunity to accelerate through additional direct selection for earlier finishing age.

- **New Commercial Beef Value (CBV).**
  - New index launched this Spring to help rearer’s identify more profitable animals for rearing/finishing.

- **National DNA calf registration.**
  - Surety re: purchased animal, including CBV. 50k calves in 2022. Can we grow?

- **Sexed Semen.**
  - Moving out dairy males and replaced with high beef merit calves.

- **New Beef Benchmarking Reports, piloted with ABP.**
  - Supporting/promoting greater technical efficiency at farm level.

- **DAFM/RDP programs focused on GHG mitigation.**
  - BDGP, BEEP, new Dairy Beef Program……future dairy programs.

- **Meat/dairy industry promotion of an earlier finishing age.**
  - Starting to happen (e.g., ABP Advantage, Glanbia-Kepak). Can we grow?
(iv) New Carbon Farming Models.

Past;
- ICBF provided Bord Bia with data for the herd carbon footprint.
- Calculations undertaken by Bord Bia, based on the Teagasc Carbon footprint model. A better way to work together?

Present;
- ICBF now undertake the calculations on Bord Bia’s behalf (Oct 2021), based on the very latest Teagasc model.
- Reports provided by Bord Bia, but “back end” data & calculations provided by ICBF, with model from Teagasc.
- Same principles now being allied for beef => summer roll-out.

Future;
- Automated data feeds from co-op’s etc => Surety re: the figures.
- Move towards “gross emissions” at the farm level => promote greater innovation around the actions that reduce GHG at the farm and industry level.
(v) **Cross-cutting** => Genotyping National Cattle Herd.

- 20% gain in accuracy from having animals genotyped at birth => “outliers” for the breeding program, removing parentage errors (~10-15....up to 30%), more accurate data for genomics.
- Having the herd genotyped => surety re: genetic merit for climate/env => available for all herds. Important for any future “carbon farming/trading” programs (i.e., surety).
- Other wider benefits for industry, e.g., dairy-beef integration, enhanced traceability, labour saving, SCC (genocells), future R&D, & market point of difference etc.
- Can we transition our National cattle herd to DNA based calf registration over next 3-5 years?
- Example of a win:win for government + industry?
  - Capital/infra-structure cost to genotype cow herd covered by government (one-off) and ongoing costs covered by all stakeholders.
  - Farmers are already contribution €5 for tags & postage. Additional €10/calf required for full DNA calf registration => genotyping National cattle herd.

- Ireland is now recognized as a world leader in the use of DNA within our agri-food industry. Can we become the number 1 and create a real “point of difference” for industry.
- Very difficult for others to mimic.
Genotyping & Dairy Beef Integration.

**Sourcing a calf to suit your system**

Starting with the correct calf type that will suit your farm system is critical to the success of a dairy beef enterprise. Declan Marren reports.

The addition of the commercial beef value (CBV) from ICBF will offer further information to farmers on this very topic, but we are not there yet.

Until we are at a level where every calf is genotyped at birth, the reliability of these figures will be questioned.

**Dairy beef issues remain**

Adam Woods takes a look at issues with dairy beef and what the Irish Limousin Cattle Society is hoping to do about it.

Many dairy farmers have chosen high-DBI bulls, but the reason many of these bulls have a high DBI index is that they are very short gestation and easy calving without paying any attention to the beef values of the bull.

On the latest round of the DBI, three out of the top five beef bulls based on dairy calving records are negative for carcase weight.

If we take a look at the latest evaluation in terms of how the top bulls on the dairy beef index are being used on farms, we can see that there are 3,880 calf registrations to dairy cows from the top five bulls on the DBI list in March 2022. Is the index being embraced by dairy farms?

- Having the herd genotyped will help build greater confidence for dairy beef integration => surety re: what we are buying.
- Help identify outliers for the breeding program;
  - Beef bulls that are good for calving AND beef.
  - Dairy bulls that are good for efficiency and Beef.
Key Decisions for Dairy & Beef Farmers – This Spring.

- Regardless of whether a dairy farmer or beef farmer:
  - Identify your herds genetics.
  - Set your breeding goal (move more towards “cost” traits).
  - Select a team of AI bulls.
  - Breed from your best cows to generate replacements.

- Next Spring……?
  - New carbon sub index in EBI.
  - New methane traits for beef indexes (based on Tully data).
  - Early finish sub index across all indexes.
Summary.

• Genetics is delivering for farmers & industry.
  • Profitability, sustainability, climate & environment.
• Genetics has the potential to deliver 1 MT of mitigation across dairy, beef and dairy beef.
• Earlier finish => an additional 1 MT, mainly through management & system changes.
• Gross emissions will be the new carbon metric at farm level => close collaboration between Teagasc, Bord Bia, ICBF and stakeholders.
• Genotyping the national cattle herd is a cross-cutting measure that has the potential to deliver for all stakeholders in many areas, including crucially GHG mitigation.