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The Role of Livestock Genetics in Addressing National GHG Mitigation Requirements.

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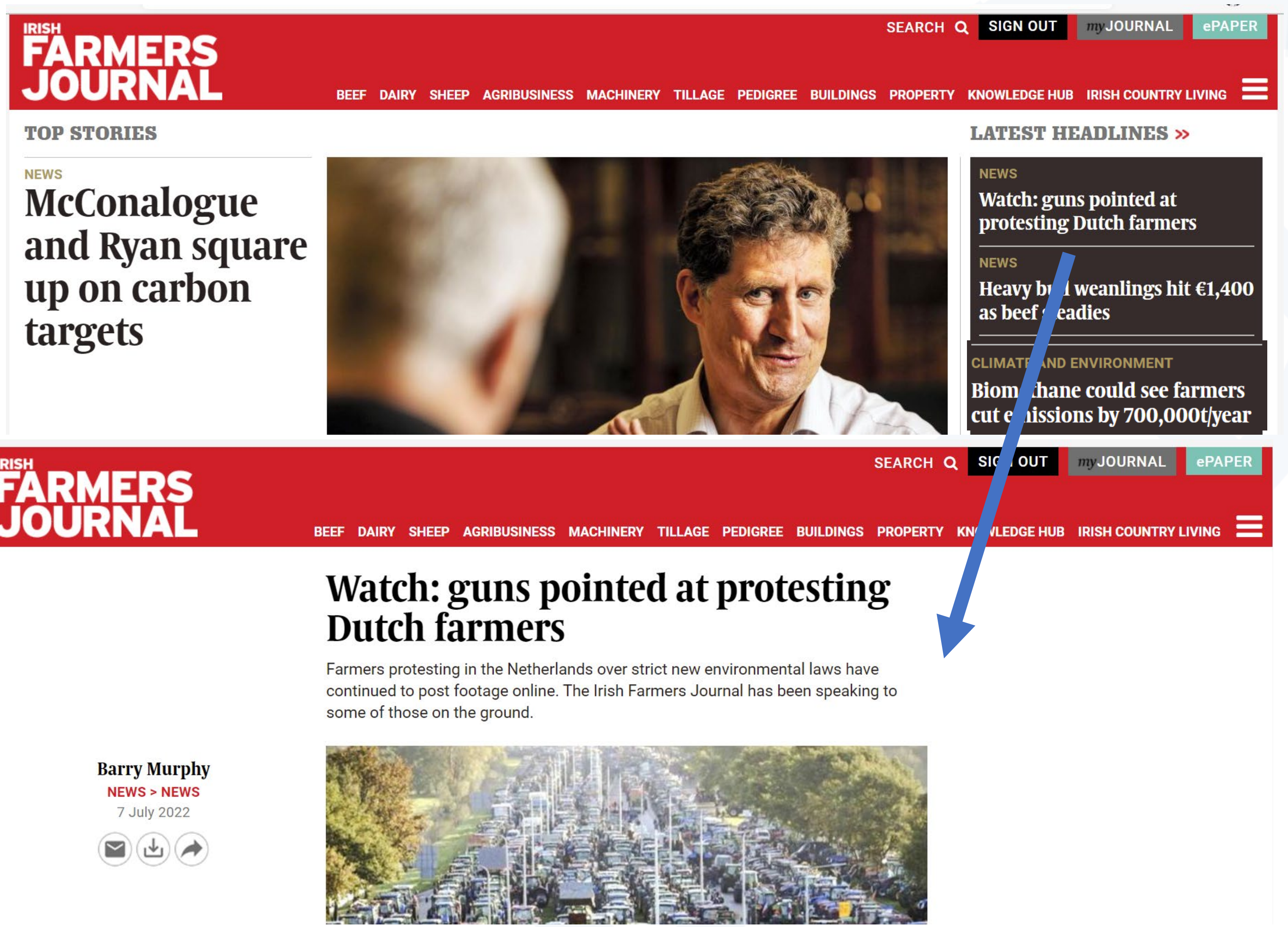
abacusbio

AgTech - it's in our DNA

Background/context *(yesterdays IFJ website).*



- Agriculture => <u>**35%**</u> of GHG total in Ireland (i.e., ~20 MT).
  - Population of 5m but produce enough food to feed 40m people!
- Irish government climate action plan => 51% reduction in GHG by 2030 & net zero by 2050.
- Sectoral targets => Agriculture <u>**must**</u> reduce by 4.5 – 6.5 MT by 2030.
- What are the genetic strategies &/or approaches that could help achieve this? What are the potential gains? What might these cost ? => **Key objectives of piece of work with AbacusBio & Teagasc.**
- Global challenge…………..=> yesterday in the Netherlands!

Impact of Different Strategies for GHG Mitigation in Dairy.

Table 1. Impact of different strategies for GHG mitigation in the Irish dairy herd (KT CO_2e)

	Description.	Fixed Output (KT CO_2e)*	Stable Herd (KT CO_2e)*
S1	Current genetic trends for Dairy Economic Breeding Index	658	69

- AbacusBio Model, with Irish input parameters.
- Current EBI Trends will deliver 658 KT mitigation (of 4.5-6.5 MT target).
  - Assumes same output but with ~100k less cows. Not reality!
- Stable herd => EBI will **not** deliver mitigation.
  - More feed & fertilizer required for more milk solids. Better fertility, but they cancel out.

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	Description.	Fixed Output (KT CO_2e)*	Stable Herd (KT CO_2e)*
S1	Current genetic trends for Dairy Economic Breeding Index	658	69
S2	Addition of a new carbon sub-index within the EBI, with increased weighting on female fertility traits.	96	108
S3	Addition of direct Methane EBVs in the breeding goal at the current economic values for methane.	67	77
S4	Increasing emphasis on new Methane EBVs in the breeding goal;30% weighting in the overall index.	85	207
S5	Inclusion of a secondary selection requirement; that only top 40% sires on methane EBV are retained for breeding.	97	101
S6	National Herd Genotyped, resulting in a 20% increase in accuracy of selection.	200	112
	Total	1,203	674

** Based on current dairy cow population of 1.6 m dairy cows producing 8.61 M Tonnes milk.*

- Current EBI Trends will deliver 658 KT mitigation (of current 4.5-6.5 MT target).
  - Assumes same output but with ~100k less cows. Not reality!
- Current EBI will not deliver mitigation.
  - More feed & fertilizer required for more milk solids. Better fertility, but they cancel out.
- Focus on additional strategies (S2 to S6) that can create GHG mitigation.
- All strategies = >674 KT.

Impact of Different Strategies for GHG Mitigation in Beef

Table 2. Impact of different strategies for GHG mitigation in the Irish beef herd (KT).

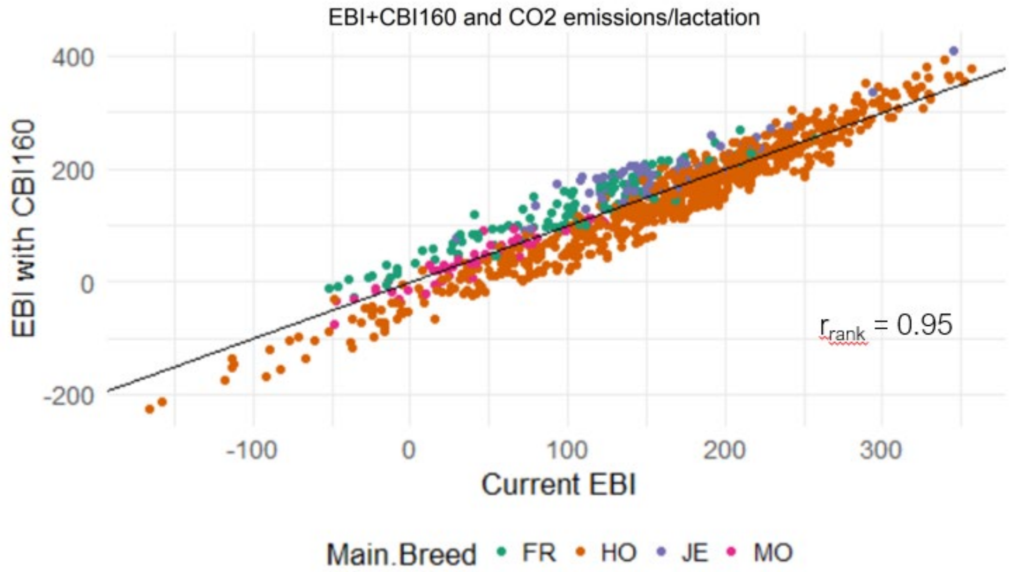
	Description.	Fixed Output (KT CO_2e)*	Stable Herd (KT CO_2e)*
S1	Current genetic trends for Beef Replacement Index	181	71
S2	Inclusion of Methane EBV's in the breeding goal at current economic values for methane.	74	78
S3	Increasing emphasis on new Methane EBV's in the breeding goal at a 30% weighting in the overall index.	91	110
S4	National Herd Genotyped, resulting in a 20% increase in accuracy of selection.	69	52
	Total	415	311

* *Based on a current beef cow population of 0.9 m cows producing 168 KT Meat.*

- Same approach taken for Beef => 311 KT.
- Beef carbon sub-index work, including earlier age at slaughter, still to be completed.
- Expect some additional gains (~100-200 KT).
- Age at slaughter gain will also flow back into gains from our dairy herd.

(i) EBI & New Carbon Sub Index.

Current EBI vs EBI+CBI (when C @ €160/t)

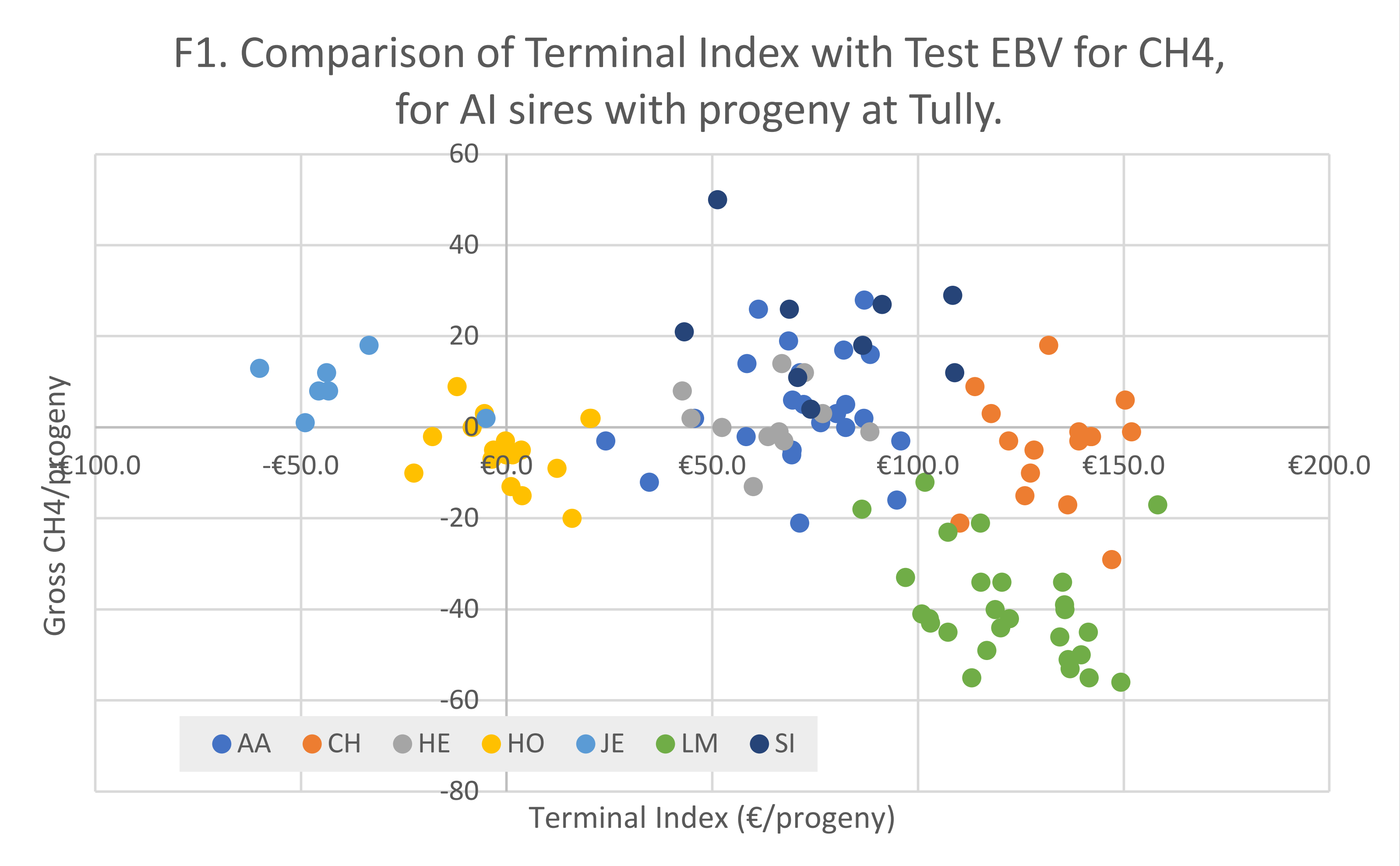


Trait	EBI	EBI+CBI160
0.2 SD	17.4	19.9
EBI	17.4	16.0
CO_2 (kg/lact.)	-8.7	-19.6
Milk SI	4.5	2.3
Calving SI	3.1	2.9
Beef SI	-0.7	-0.9
Fertility SI	9.7	10.7
Health SI	0.1	0.01
Mngmt. SI	0.4	0.3
Maint. SI	0.3	0.16

[1]Assuming current EBI trend is 0.2 index SD/yr.

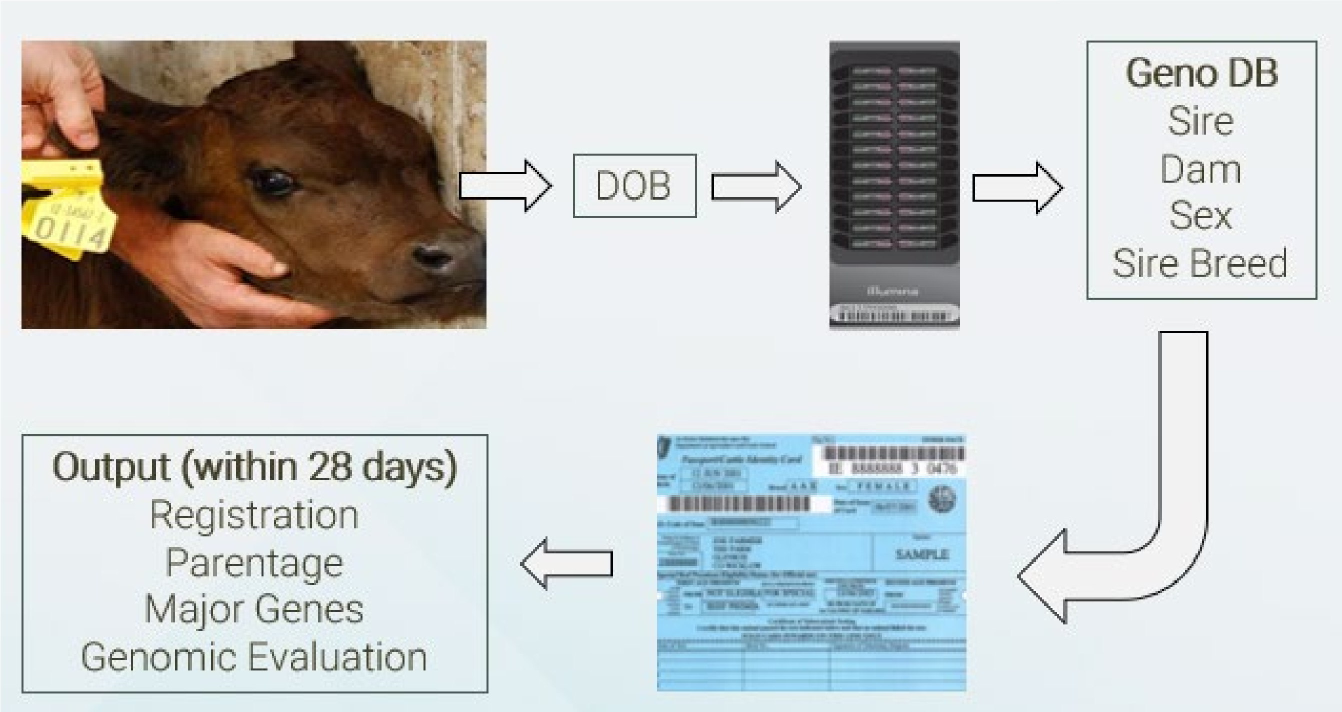
- Opportunity to double the gain (+225%) but will require us shift 15% of index onto a new “carbon sub-index”.
- Relative gain in “profit” from EBI will be reduced by 8%, less gain in milk sub-index and more female fertility.
- Expect some level of re-ranking (r=0.95), but farmers/industry are supporting. Could we push further??

(ii) Breeding for lower methane – Initial Results.



- Part of G€N€ IR€LAND Breeding program => 1200 progeny records from range of AI sires (all breeds).
- Big variation for Gross Emissions.
  - Mean of ~250 g/day during finishing period, with some sires being +20 (~270 g/day) and others being -50 (~200 g/day).
- Selecting for "more efficient animals, in terms of carcass growth & cost of feed is taking us in the right direction.
  - Other traits, still be considered, e.g., earlier finishing age.
- Results are based on a finishing diet. Now need to repeat for growing part of animal's life + crucially at grass/off grass, including cows.
- Genomic evals for methane in 2023.

(iii) Genotyping every Calf.



- 20% gain in accuracy from having animals genotyped at birth => "outliers" for the breeding program, removing parentage errors (~12%), more accurate data for genomic predictions.
- Having the herd genotyped => surety re: genetic merit for climate & environment => available for all herds. Important for any future "carbon farming/trading" programs (i.e., surety).
- Other wider benefits for industry, e.g., 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?

Value of Genotyping Every Calf.

Table 1: Summary of present value of gross economic benefits (€m) of genotyping every calf in Ireland, for dairy and beef production systems over a 10-year period.

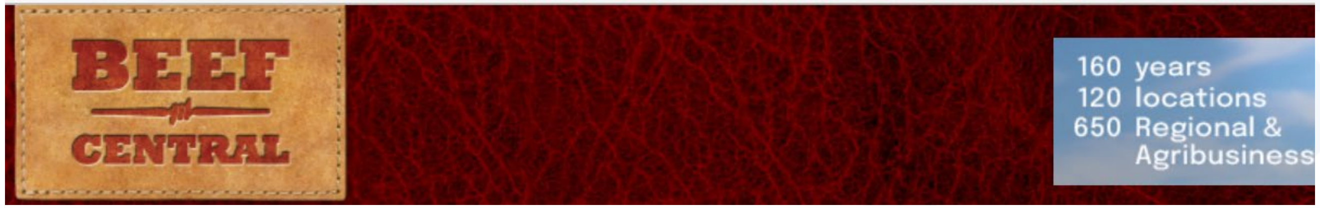
	Dairy	Beef
1. Improved rate of genetic gain due to increased accuracy	221.4	63.4
2. Improved quality of stock bulls	131.4	47.3
3. Price improvement due to improved supply chain integrity	118.1	68.4
4. Industry operational cost savings	64.9	38.9
5. Cost savings for environmental audits	21.2	21.2
Total (Present value)	**557.1**	**239.2**

Table 3: Net present value (€m) of genotyping every calf in Ireland (benefits for dairy and beef combined) over a 10-year period, under realistic and optimistic cost of genotyping scenarios.

	Current	Future (€15)	Future (€10)
Benefit (equal under each scenario; €m)	796.3	796.3	796.3
Cost (€m)	339.8	254.8	169.9
Net present value (€m)	**456.5**	**541.5**	**626.4**

- Value of genotyping every calf estimated at €796m.
- Future cost of €10/animal.
  - Farmers buys the tag + postage & package (€5/animal) with balance coming from govt & industry.
- ~4:1 Benefits relative to Costs.
- Current engaged with all stakeholders re: this proposition.
- Cost prohibitive. What about alternatives?

Which Option; Additives or Genetics?



Methane-reducing seaweed additive now commercially available for beef producers

Beef Central, 30/06/2022

Strategies for R&D for emissions reduction for the beef and sheep industries in Australia: how much to invest, and where to spend it?

Emissions reduction: if management tools work do we need genetics?

Robert Banks

Ex-AGBU

- Now huge interest/investment in additives as a key delivery tool for GHG mitigation.
- **But,** a number of relevant questions?
  - How will we validate their impact?
  - Will there be side effects (milk & meat).
  - How will consumers view their use?
  - What will the adoption rates be, especially in grass-based systems.
  - What will they cost farmers & industry, from research to implementation (~€100/animal).
  - How long will they have to pay these costs……for ever?
- What are the answers to the above questions from a genetics standpoint?

Summary.

- Genetics is a trusted and proven technology that will deliver.
  - Profitability, sustainability, climate & environment.
- Genetics has the potential to deliver 1-1.5 MT of GHG mitigation in dairy and beef, of Irish governments 4.5-6.5 MT requirement for agriculture.
  - Key initiatives include; carbon sub indexes, direct selection on methane and DNA'ing every calf. More "in pipe-line", e.g., age at slaughter.
  - Marginal reduction in profit (~8%)….but farmers are very positive about changes => *slight re-positioning for something that is critically important.*
- Genotyping the National cattle herd => 4:1 return on investment.
  - Increased genetic gain, but future surety re: GHG auditing.
- Make the case…….otherwise the money will be spent elsewhere!

Final Thoughts.

- Climate change => A global challenge.
- Urgent need for greater international collaboration (data, models, evaluations etc).
  - R&D => 1000 genomes, Breed4Food, GenTore, MethaGene…
  - Future services => ICAR, Interbull, Interbeef, ABRI-Breedplan, BIF, IGS, US Angus……….
- What's the alternative…………..lab proteins?!
- Or one where animals & plants can interact in their natural eco-systems.
- As geneticists, surely that's worth **aspiring** to?