Possible principles for breed association models in the genomics era, with reference to beef cattle and sheep breeds

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The future for breed associations, societies

- Is as R&D organisations, aiming to:
  - Maxmise $r\delta$ per funds invested for some defined gene pool
  - Maxmise $ir/L$

- This will require:
  - New forms of association
  - New pricing and rewarding models
  - Likely long-term partnerships with others in the value chain (either private and/or public)
Perspectives, within and between countries:

• Within-country “rules”:
  – Have to be equitable and efficient
  – Must have well-designed incentives/rewards, and minimise free-riding

• Between-country:
  – Sharing data is almost invariably a win-win (benefit may be small, but cannot be negative)
  – Shared or coordinated design – young sire sampling, designed phenotyping and genotyping – will increase value
  – Estimating $r_g$ between countries for objectives and for traits should be core activities
  – These are true irrespective of whether there is one evaluation or many

• Are these consistent?
  – Do “breeds” need to work as global partnerships or networks to survive?
Genomic selection is a radical innovation (breaks the nexus between records and EBVs)

But it requires radical organisational innovation to obtain benefits:
- New models for coordinated breeding program design
- New partnerships to achieve those new models
  - ideally whole chain
- Focus on creation of information and harvesting its value, not on dragging breeders into new technology
- As always, effective cooperation can generate greatest long-term benefits
- We need clever thinking and R&D
A (bad) example - the Australian energy market

- Sources of energy:
  - Coal-fired
  - Natural gas (on- and off-shore)
  - Hydro-electric
  - Wind
  - solar

- Rapid change in relative properties of sources
  - Cost
  - reliability

- “market” is a mix of state and private entities, with a regulator

- Chronic problems of over-investment in some components (poles and lines), coupled with extremely inefficient signalling & rules, and apparently limited appreciation of scope for gaming ie network architecture
Breed associations:

- Some core services (database, staff, analysis)
- Multiple diverse members:
  - Differ in behaviours (recording, selection, marketing)
    - Recording effort seems to be repeatable
    - Selection effort not repeatable
  - Differ in contribution (a power law distribution)
- Incentives
  - Internal and external sales
- Externalities
  - Exist with P and pedigree
    - Exponentially more with genomics
- Rules and decision-making – around purity and charges
- Is there a reason to care?
Key challenges:

• Managing variation, not imposing conformity
  – Maximal variation in animals is ideal

• Meeting customer expectations
  – Minimal variation is ideal

• Aggregating diverse data to produce information
  – Different data has different value

• Core costs are unchanged, so you have data + core processing gives rise to EBVs (etc) which give rise to selection and multiplication
  – Data + process $\rightarrow$ information $\rightarrow$ decisions (selection, multiplication)
  – $v(data) \rightarrow v(information) \rightarrow v(selection)$
Simple case:

- 1 reference population (n = 1,000), where all recording takes place
- A breeding nucleus (n = 10,000) which produces bulls, which breed commercial progeny (n = 360,000)
- Divide total reference population cost across bulls, heifers, and commercial progeny
- Should we charge more for tests on bulls and heifers because they have more expressions?
  - c. 44 expressions per nucleus bull or heifer
  - 1 expression per commercial animal
- Charging too much or too little will cause distortions
- Can differential charging work?
  - If reference costs $1m pa, royalty for nucleus animals = $55, and for commercial = $1
Real life:

• Reference population:
  – Some defined collective investment in HTM traits
  – Some variable investment by individuals in other traits

• Costs in total:
  – HTM traits
  – Other traits, variable investment per animal (and per breeder)
  – Core database and analysis, and other overheads
  – genotyping

• Recouping costs, principles are the same as for the simple case
• So, should system recognise variation in “other trait” recording?
Pros and cons:

• If market already rewards genetic superiority, is there a risk of double counting?
• Reward function needs to:
  – Be non-linear (because returns are not unlimited, and oversubscription will bankrupt you)
  – Reflect overall return for investment ie the regression of reward on increment of objective accuracy must be the right level
• What about generating optimal recording and mating sets, and “penalising” deviations
Two “easy” solutions:

• Completely rule-defined, allowing no variation:
  – More cost to implement (who pays?)
  – Needs very strong belief in the rules, and ultimate success
  – Who sets the rules?

• Completely market-based
  – Very easy (“the market decides”)
  – Implementation risk is minimised
  – Outcome risk is maximised

• Neither is ideal
Principles:

- Phenotypes vary in quality, or value – this needs to be recognised, ideally at the point or time of that decision.
- Variation in selection (direction, rate) affect both the individual and the breed – needs to be minimised.
- Mechanism for “payment”
  - Cash is impossible for most organisations
  - Waiving royalties, and/or providing advice is more feasible.
- Would point of decision apps help shift all decisions towards optima?
- Rewards or incentives must have limits, and are likely to reinforce any market rewards – risk of emigration.