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

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# 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:**
  - **Maximise $r.\delta_{\$}$ per funds invested for some defined gene pool**
  - **Maximise 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?**

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# Summary:

- 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

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# 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

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# 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 ➡ information ➡ decisions (selection, multiplication)
  - v(data) ➡ v(information) ➡ 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