Derivation of economic values for breeding goal traits in four different production systems (The optimal cow)

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Before the genomic era
- Many progeny tested bulls needed for substantial $\Delta G$
- Big populations needed
- Break-even correlation appr. 0.85 (Depending on pop. size)

Today
- Good reference populations needed
  - Much smaller than the number of test daughters needed before
- Genomic tests cost money
- Break-even correlation $>> 0.85$
Breeding goal - theory

- The ideal way:
  - Derive marginal economic value, keeping the remaining traits constant

- Wolfova and Wolf (2013, Animal)
  - On the issue of double counting
    - Do not include genetic correlations in the derivation
    - Include structural changes in the derivation

Structural relationships
an example

Improved health

Longer lasting cows

The consequence is lower weight on longevity, because the weights is put were it belongs to.
Breeding goal - practice

- Experience from the NTM work:
  - Interactions between yield, functional traits and longevity are difficult to handle.

Method

- Mechanistic, dynamic and stochastic simulation in SimHerd (Østergård et al., 2014, Østergård et al., 2016 (JDS)
  - Phenotypic correlations included
  - Structural interactions included
Method

- direct effect of X on Y = c
- indirect effect of X on Y = a * b
- direct effect of X on Y with the effect of the mediator removed = c'

Fairchild and MacKinnon, 2009

Investigated production systems

- Conventional
  - Average Danish, conventional dairy herd in term of production, reproduction and health
- Organic
  - Organic milk level, slightly better health, higher prices for milk and feed
- Environment
  - High management level and use of beef semen to reduce young stock herd
- Hi-Tec
  - High management level due to low disease treatment threshold and automatic heat detection
### Results – Selected traits for HF

Relative economic values across environments within traits

<table>
<thead>
<tr>
<th>Trait</th>
<th>Conv.</th>
<th>Organic</th>
<th>Hitec</th>
<th>Env.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>100</td>
<td>121</td>
<td>93</td>
<td>98</td>
</tr>
<tr>
<td>Feed efficiency</td>
<td>100</td>
<td>123</td>
<td>103</td>
<td>101</td>
</tr>
<tr>
<td>Cow mortality</td>
<td>100</td>
<td>102</td>
<td>112</td>
<td>114</td>
</tr>
<tr>
<td>Milk fewer</td>
<td>100</td>
<td>338</td>
<td>202</td>
<td>99</td>
</tr>
<tr>
<td>Mastitis (infectious)</td>
<td>100</td>
<td>205</td>
<td>109</td>
<td>108</td>
</tr>
<tr>
<td>Digital Dermatitis</td>
<td>100</td>
<td>101</td>
<td>81</td>
<td>100</td>
</tr>
<tr>
<td>Conception rate, cows</td>
<td>100</td>
<td>48</td>
<td>82</td>
<td>133</td>
</tr>
<tr>
<td>Conception rate, heifers</td>
<td>100</td>
<td>110</td>
<td>106</td>
<td>65</td>
</tr>
<tr>
<td>Longevity</td>
<td>100</td>
<td>108</td>
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### Explanations - yield

- Organic: High EV’s because of higher prices for organic milk and higher costs for organic feed
Explanations - Health

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- Organic: High EVs due to restrictions on use of antibiotics
- Hitec: High EV for milk fewer because of more older cows

Explanations - fertility

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- Organic: Low EV for conception rate in cows due to high rearing costs
- Organic: High EV for conception rate in heifers, also due to high rearing cost
- Environmental: Low EV for conception rate in heifers because of fewer heifers in this production system
Explanations - longevity

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- Hitec: High EV for longevity because older cows are more healthy in this system and therefore they are more valuable.
- Env: High EV for longevity because durable cows are important in order to keep the low replacement rate.

Part conclusions

- The derived EV’s are VERY dependent on production assumptions
- The estimated correlations between the four different breeding goals are quite high
- Including farmer preferences may alter this
- Including G*E interactions may alter this
Heterogeneity in farmer preferences for breeding goal traits - effects of herd characteristics and production system

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¹ Aarhus University, Denmark, ² SEGES, Denmark, ³ VikingGenetics

Mainly prepared by Margot Slagboom

Including farmer preferences

Weight in breeding goal = Economic value + Organic preferences

- Economic model (Simherd)
- The farmer survey
Why survey to farmers?

- Economic models don’t account for everything
  - Organic principles

- Create ownership
  - Ensure the breeding goal reflects farmers’ requirements

This study

- Aim: To quantify preferences of Danish dairy farmers for breeding goal traits and associations to herd characteristics and production system.

- Hypothesis: Heterogeneity exists within farmers’ preferences and herd characteristics and production system can be linked to farmers’ choices for trait improvements.
The survey

- Improvements are economically equal
- Based on economic weights of simulation study for an organic system

<table>
<thead>
<tr>
<th>Trait</th>
<th>Holstein</th>
<th>RDM</th>
<th>Jersey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed efficiency</td>
<td>0.010</td>
<td>0.010</td>
<td>0.010</td>
</tr>
<tr>
<td>Milk production</td>
<td>38</td>
<td>35</td>
<td>33</td>
</tr>
<tr>
<td>Cow fertility</td>
<td>39</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Heifer fertility</td>
<td>11</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Calving difficulty</td>
<td>-8.2</td>
<td>-8.6</td>
<td>-8.5</td>
</tr>
<tr>
<td>Mastitis</td>
<td>-5.3</td>
<td>-5.0</td>
<td>-5.1</td>
</tr>
<tr>
<td>Other diseases</td>
<td>-10.1</td>
<td>-10.9</td>
<td>-8.6</td>
</tr>
<tr>
<td>Leg and claw diseases</td>
<td>-13.5</td>
<td>-13.9</td>
<td>-17.9</td>
</tr>
<tr>
<td>Calf mortality</td>
<td>-12</td>
<td>-64</td>
<td>-23</td>
</tr>
<tr>
<td>Cow mortality</td>
<td>-1.8</td>
<td>-1.8</td>
<td>-1.7</td>
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</table>
The survey

- Organic and conventional farmers

- Breed specific survey
  - Holstein, RDM, Jersey

Response

- Trait rankings per farmer (1 highest - 10 lowest)

- Number of respondents

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<tr>
<td>Organic (48%)</td>
<td>106</td>
<td>29</td>
<td>27</td>
</tr>
<tr>
<td>Conventional (13%)</td>
<td>290</td>
<td>58</td>
<td>49</td>
</tr>
<tr>
<td>Total (16%)</td>
<td>396</td>
<td>87</td>
<td>76</td>
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</tbody>
</table>
Organic Holstein

- Cluster 1: Robustness
- Cluster 2: Production and mastitis
- Cluster 3: Production and fertility
- All trait ranks different between clusters
- No differences in herd characteristics
Conventional Holstein

- Cluster 1: Health
- Cluster 2: Survival
- Cluster 3: Production and fertility
  - Comparable to cluster 3 organic Holstein
- Differences in herd characteristics
  - Statement 4, 5 and 6
Summary Holstein

- Clear farmer types found

- Roughly the same farmer types for organic, conventional and organic + conventional

- Organic farmers more emphasis on production traits

- Some differences in herd characteristics

RDM

- Different weights in the survey
  - Based on economic weights for a RDM herd

- 29 Organic herds
- 58 Conventional herds

Low number of herds!

Organic and conventional analysed together
• Cluster 1: Robustness

• Cluster 2: Production and health

• Cluster 3: Production and fertility
RDM

• Differences in herd characteristics
  – Crossbreeding between dairy breeds
  – ECM
  – Herd size
  – Percentage of organic farmers

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<tr>
<td>ECM</td>
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More robust cows, more crossbreeding?

RDM

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Rank production trait the lowest
RDM

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Part conclusions

• Heterogeneity exists within farmers’ preferences
  – Clear groups of farmers found for all breeds

• Some herd characteristics can be linked to farmer groups

• Production system can be linked to farmer groups
Overall conclusions

- Improved tools which can be used for making an update/revision of NTM? YES this can in combination with the present excel sheet be used for an update of NTM
- What can be learned from a breeding goal survey? Dairy farmers are diverse. Customised indices an obvious opportunity (– better than minimum selection at herd level).
  Division of breeds in lines require more investigations (e.g. SOBcows)