Heterogeneity in farmer preferences for breeding goal traits - effects of herd characteristics and production system

Meeting at VikingGenetics, Assentoft
4th of December 2015

M. Slagboom, M. Kargo, L. Hjortø, J. R. Thomasen, D. Edwards

Undersøgelsen er en del af Organic RDD 2-projektet SOBcows
Outline

• Introduction
• Materials and methods
• Holstein results
• RDM results
• Jersey results
• Conclusions
Breeding goal

• Based on economic weights

• Farmer preferences
  – What do farmers want? → Ownership of the breeding goal
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

Preferences survey
Please reveal your preferences by answering the following questions.

Question #1

Which of these two alternatives do you prefer?
(given they’re identical in all other respects)

- Milk production
  +38 kg ECM per 305 days lactation

- Mastitis
  As in your herd today

- Milk production
  As in your herd today

- Mastitis
  5.3 less cases per 100 cows

OR

they are equal

skip this question for now »
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>
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<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>
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<tr>
<td>Other diseases</td>
<td>-10.1</td>
<td>-10.9</td>
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<tr>
<td>Leg and claw diseases</td>
<td>-13.5</td>
<td>-13.9</td>
<td>-17.9</td>
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<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>
</tr>
</tbody>
</table>

kg ECM per feed unit
kg ECM per 305 days lactation
Additional pregnancies per 100 inseminations
Cases per 100 cows
Cases per 100 cows
The survey

• Organic and conventional farmers

• Breed specific survey
  – Holstein, RDM, Jersey
General questions

• Herd characteristics
  – ECM, herd size, crossbreeding between dairy breeds, etc.

• For conventional (1: strongly agree; 5: strongly disagree)
  1. The choice of an optimal breeding strategy for my herd is important for the operational return in my herd.
  2. NTM is my primary criterion for choice of AI bulls.
  3. The present level for udder conformation among my cows fits my production system.
General questions

• For conventional (1: strongly agree; 5: strongly disagree)
  
4. The present level for feet and leg conformation among my cows fits my production system.

5. The present level for body conformation among my cows fits my production system.

6. Uniformity with regard to the cows’ size is an important trait.
Response

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

• Number of respondents

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<tbody>
<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>
</tr>
</tbody>
</table>
Methods

• Friedman test for mean trait rank differences

• Principal component analysis
  – No evidence for reducing dimensions

• Cluster analysis
  – No. of clusters based on gain of inertia

• Differences between clusters
  – Kruskal-Wallis + Dunn’s test for pairwise differences
Holstein
Organic Holstein
Organic Holstein
Organic Holstein

![Graph showing various metrics such as Calf mortality, Calving difficulty, Cow fertility, Cow mortality, Feed efficiency, Heifer fertility, Leg and claw diseases, Mastitis, Milk production, and Other diseases for All farmers, Cluster 1, Cluster 2, and Cluster 3.](image)
Organic Holstein

Cluster 1: Robustness

Disease traits
- Calf and cow mortality

Milk production
- Feed efficiency

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Organic Holstein

Cluster 2: Production and mastitis

Cluster 2:
- Production
- Mastitis
- Feed efficiency

Milk production
Mastitis
Heifer fertility
Calf and cow mortality

Comparison of indicators across clusters:

- Calf mortality
- Calving difficulty
- Cow fertility
- Cow mortality
- Feed efficiency
- Heifer fertility
- Leg and claw diseases
- Mastitis
- Milk production
- Other diseases
Organic Holstein

Cluster 3: Production and fertility

Cow and heifer fertility
Milk production
Calving difficulty
Disease traits

Cluster 1
Cluster 2
Cluster 3
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
Conventional Holstein
Conventional Holstein

- Calf mortality
- Calving difficulty
- Cow fertility
- Cow mortality
- Feed efficiency
- Heifer fertility
- Leg and claw diseases
- Mastitis
- Milk production
- Other diseases

Clusters:
- All farmers
- Cluster 1
- Cluster 2
- Cluster 3
Conventional Holstein

Cluster 1: Health

- Leg and claw diseases
- Mastitis
- Other diseases

Cluster 2:

Cluster 3:

- Cow and heifer fertility
- Calf mortality

Legend:
- All farmers
- Cluster 1
- Cluster 2
- Cluster 3
Conventional Holstein

Cluster 2: Survival

- Calf mortality
- Calving difficulty
- Cow fertility
- Cow mortality
- Feed efficiency
- Heifer fertility
- Leg and claw diseases
- Mastitis
- Milk production
- Other diseases

Cluster 1

Cluster 2

Cluster 3

All farmers
Cluster 1
Cluster 2
Cluster 3
Conventional Holstein

Cluster 3: Production and fertility

- Cow and heifer fertility
- Milk production
- Feed efficiency
- Calving difficulty
- Disease traits

Bar chart showing various traits for different clusters and all farmers.
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
Conventional Holstein

4. The present level for feet and leg conformation among my cows fits my production system.

5. The present level for body conformation among my cows fits my production system.

6. Uniformity with regard to the cows’ size is an important trait.

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<th>Kruskal-Wallis p-value</th>
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<tbody>
<tr>
<td>Statement 4</td>
<td>2.70</td>
<td>2.89</td>
<td>2.71</td>
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<tr>
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Ranked leg and claw diseases the highest! 1: strongly agree; 5: strongly disagree
Conventional Holstein

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1: strongly agree; 5: strongly disagree

Production and fertility related to uniformity and body conformation?
Org. + Conv. Holstein

Hierarchical Clustering

Tree and suggested number of clusters

inertia gain
Org. + Conv. Holstein

Calf mortality
Calving difficulty
Cow fertility
Cow mortality
Feed efficiency
Heifer fertility
Leg and claw diseases
Mastitis
Milk production
Other diseases

Cluster 1
Cluster 2
Cluster 3
Cluster 4

All farmers
Org. + Conv. Holstein

Cluster 1: Health and fertility

Disease traits
- Heifer and cow fertility
- Feed efficiency
- Milk production
- Cow mortality

Feed efficiency

- All farmers
- Cluster 1
- Cluster 2
- Cluster 3
- Cluster 4

Traits:
- Calf mortality
- Calving difficulty
- Cow fertility
- Cow mortality
- Feed efficiency
- Heifer fertility
- Leg and claw diseases
- Mastitis
- Milk production
- Other diseases
Cluster 2: Production and mastitis
Org. + Conv. Holstein

Cluster 3: Survival

Cow mortality
Calf mortality
Calving difficulty
Feed efficiency
Milk production

Disease traits

Cluster 1
Cluster 2
Cluster 3
Cluster 4
Org. + Conv. Holstein

Cluster 4: Production and fertility

- Cow and heifer fertility
- Milk production
- Feed efficiency
- Disease traits

- Calving difficulty

Cluster 4: Production and fertility

Graph showing various traits such as calf mortality, calving difficulty, cow fertility, cow mortality, feed efficiency, heifer fertility, leg and claw diseases, mastitis, milk production, and other diseases, categorized by different clusters.
Org. + Conv. Holstein

• Cluster 1: Health and fertility

• Cluster 2: Production and mastitis
  – Comparable to cluster 2 organic Holstein

• Cluster 3: Survival
  – Comparable to cluster 3 conventional Holstein

• Cluster 4: Production and fertility
  – Comparable to cluster 3 organic and conventional Holstein
### Org. + Conv. Holstein

- Differences in herd characteristics
  - ECM
  - Percentage of organic farmers

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<thead>
<tr>
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<tr>
<td>ECM</td>
<td>10111</td>
<td>10389</td>
<td>9879</td>
<td>10132</td>
<td>10043</td>
<td>0.05</td>
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<tr>
<td>Organic</td>
<td>20%</td>
<td>13%</td>
<td>22%</td>
<td>20%</td>
<td>25%</td>
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Ranked production traits the lowest

Ranked production traits the highest
Org. + Conv. Holstein

- Differences in herd characteristics
  - ECM
  - Percentage of organic farmers

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Lowest percentage of organic farmers

Highest percentage of organic farmers
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
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
<table>
<thead>
<tr>
<th>Category</th>
<th>All farmers</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Cluster 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf mortality</td>
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<tr>
<td>Other diseases</td>
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</tbody>
</table>
Cluster 2: Production and health

Feed efficiency
Disease traits
Milk production
Heifer and cow fertility
Calving difficulty
RDM

Cluster 3: Production and fertility

- Heifer and cow fertility
- Milk production
- Leg and claw diseases
- Other diseases
- Mastitis

Bar chart showing comparisons among different clusters for various farm performance indicators:

- Calf mortality
- Calving difficulty
- Cow fertility
- Cow mortality
- Feed efficiency
- Heifer fertility
- Leg and claw diseases
- Mastitis
- Milk production
- Other diseases

Legend:
- All farmers
- Cluster 1
- Cluster 2
- Cluster 3
RDM

• 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

<table>
<thead>
<tr>
<th>Item</th>
<th>All farmers</th>
<th>Cluster 1: Robustness</th>
<th>Cluster 2: Production and health</th>
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</thead>
<tbody>
<tr>
<td>Crossbreeding</td>
<td>16%</td>
<td>33%</td>
<td>17%</td>
<td>6%</td>
<td>0.04</td>
</tr>
<tr>
<td>ECM</td>
<td>9167</td>
<td>97723</td>
<td>9322</td>
<td>8733</td>
<td>0.01</td>
</tr>
<tr>
<td>Herd size</td>
<td>137</td>
<td>153</td>
<td>156</td>
<td>113</td>
<td>0.05</td>
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<tr>
<td>Organic</td>
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More robust cows, more crossbreeding?
RDM

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

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Rank production trait the lowest
RDM

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

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Lowest percentage of organic farmers
Jersey
Jersey

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

- 27 Organic herds
- 49 Conventional herds

Organic and conventional analysed together
Jersey
Jersey

Hierarchical Clustering

Tree and suggested number of clusters
Cluster 1: Production and fertility

- Heifer and cow fertility
- Milk production
- Feed efficiency

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<tr>
<td>Calf mortality</td>
<td>5.0</td>
<td>5.0</td>
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Cluster 2: Production and robustness
Jersey

Cluster 3: Survival

- Calf mortality
- Cow mortality
- Cow fertility
- Feed efficiency
- Milk production
- Other diseases

Cluster 1
- Calf mortality
- Calving difficulty
- Cow fertility

Cluster 2
- Feed efficiency
- Milk production

All farmers
- Calf mortality
- Calving difficulty
- Cow fertility
- Feed efficiency
- Milk production
- Other diseases
Jersey

- Cluster 1: Production and fertility
- Cluster 2: Production and robustness
- Cluster 3: Survival
Jersey

- Not all traits ranks significantly different
  - Calving difficulty and mastitis

- Differences in herd characteristics
  - Percentage of organic

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<tr>
<td>Organic</td>
<td>36%</td>
<td>44%</td>
<td>19%</td>
<td>43%</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Lowest percentage of organic farmers
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
Further work

• Data from cattle database → more herd characteristics to compare between clusters

• Simulate long term effects for different breeding goals

• Customized breeding indices?
  – Increases ownership of the breeding goal
  – Martin-Collado *et al.*, 2015
Questions?