Top Reproductive Performance of Dairy Cattle in Tropical Climate with Assisted Technology

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<table>
<thead>
<tr>
<th>Commodity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biofuels</td>
<td>Ethanol, biodiesel</td>
</tr>
<tr>
<td>Cereals</td>
<td>Wheat, rice, coarse grains</td>
</tr>
<tr>
<td>Cotton</td>
<td></td>
</tr>
<tr>
<td>Dairy</td>
<td>Butter, cheese, milk, whole milk powder, skim milk powder, whey powder, casein</td>
</tr>
<tr>
<td>Fish</td>
<td>Capture fisheries, aquaculture</td>
</tr>
<tr>
<td>Meat</td>
<td>Beef and veal, poultry, sheepmeat, pigmeat</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>Oilseeds, protein meals, vegetable oils</td>
</tr>
<tr>
<td>Sugar</td>
<td>Sugar, raw sugar, white sugar</td>
</tr>
</tbody>
</table>
What is the MOST important -

GOAL?
Here to listen and ask questions

- Exchange of ideas and information
- Make some suggestions
- Have a program that serves the needs
- Farmers are the customer
- Consumers are the customer of farmer
What is the MOST important -

GOAL?

Photographs, Illustrations
256 pages, 245 x 170 mm
Publisher: CSIRO Publishing
February 2015
ISBN: 9781486301614
To obtain a live calf....
This goal leads to:

• Milk production
• Replacement of mother
• Herd expansion
• With better animal?
  – Genotypic
  – Phenotypic
• Gaining a economic return $$$
How does it happen?

• Some thoughts and ideas…
• Reach for the sky…
Hard to get cows in the sky -

Jay Mattison CEO, USA National DHIA
Quality Certification Services
Vice President ICAR
• Look at the big picture
• From 10,000 meters high
• From my 1 meter (or liter)
• Genetics is additive and permanent
• Management is more changeable
A unit of semen is really –

Data

In a plastic straw
Decisions are still – Data Driven
Having the right DATA requires

- Milk recording (MUST HAVE)
- Management (SHOULD HAVE)
- Conformation (NICE TO HAVE)
Data Collection - Decisions

Data opportunities:

**Phenotypic info:**
- Production
- Conformation

**Genotypic info:**
- Pedigree
- Breeding values
- Genomics?

**Farmer info:**
- Breeding Goal(s)
- Management Issues

**Matings:**
- Inbreeding management
- Genetic recessives
- Shopping list of sires

Combine and leverage the data available!
Having the available DATA:

- Puts farmer in the “knowledge loop”
- Allows “Data Driven Decisions”
Development of DECISIONS based on DATA

• Decision tools for managing replacement heifer inventory (buying, selling, keeping, culling)

• Decision tools for interfacing with other technologies such as sexed semen

• Genetic guided mate selection

• Genetics assisted management systems based on
  – Genotype x Environment
  – Genotype x Diet
  – Genotype x Management Practice
Having the available DATA:

- Domestic
  - Management and Genetics
- From other countries
  - Management and Genetics
  - Units and comparison?
- Interbull
  - Neutral aggregator
Data Collection to Breeding

Business process:

Famer Goals and Decisions  →  Semen or Sire Choice  →  Semen Delivery  →  Breeding  →  Calf Born

Success....
<table>
<thead>
<tr>
<th>Calving Year</th>
<th>Head</th>
<th>First Calving (Head)</th>
<th>First Calving (%)</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
<th>29</th>
<th>30</th>
<th>31</th>
<th>32</th>
<th>33</th>
<th>34</th>
<th>35</th>
<th>36</th>
<th>Less than 24 month (%)</th>
<th>Less than 27 month (%)</th>
<th>Less than 30 month (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>7608</td>
<td>2923</td>
<td>38.4</td>
<td>1.0</td>
<td>1.4</td>
<td>3.5</td>
<td>6.0</td>
<td>10.5</td>
<td>12.2</td>
<td>10.6</td>
<td>10.0</td>
<td>10.1</td>
<td>8.5</td>
<td>6.4</td>
<td>5.1</td>
<td>4.1</td>
<td>2.7</td>
<td>2.7</td>
<td>2.0</td>
<td>2.5</td>
<td>23</td>
<td>56</td>
<td>81</td>
</tr>
<tr>
<td>2005</td>
<td>27890</td>
<td>5236</td>
<td>18.8</td>
<td>0.6</td>
<td>0.7</td>
<td>1.5</td>
<td>3.8</td>
<td>6.2</td>
<td>8.1</td>
<td>10.2</td>
<td>11.0</td>
<td>9.0</td>
<td>7.5</td>
<td>7.9</td>
<td>6.3</td>
<td>6.2</td>
<td>4.9</td>
<td>5.6</td>
<td>4.9</td>
<td>4.6</td>
<td>13</td>
<td>43</td>
<td>67</td>
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<tr>
<td>2001</td>
<td>24405</td>
<td>4685</td>
<td>19.2</td>
<td>0.2</td>
<td>0.9</td>
<td>2.3</td>
<td>3.5</td>
<td>7.3</td>
<td>8.8</td>
<td>8.5</td>
<td>9.3</td>
<td>9.8</td>
<td>10.7</td>
<td>10.1</td>
<td>7.1</td>
<td>5.9</td>
<td>4.6</td>
<td>3.9</td>
<td>3.4</td>
<td>2.9</td>
<td>14</td>
<td>41</td>
<td>72</td>
</tr>
</tbody>
</table>
### Age at First Calving of Dairy Cattle in Taiwan

(Acquire date: 2015/7/11)

<table>
<thead>
<tr>
<th>Calving Year</th>
<th>Head</th>
<th>First Calving (Head)</th>
<th>First Calving (%)</th>
<th>Age at First Calving (20~36 Months)</th>
<th>Less than 24 month % (hd)</th>
<th>Less than 27 month % (hd)</th>
<th>Less than 30 month % (hd)</th>
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</thead>
<tbody>
<tr>
<td>2015</td>
<td>7608</td>
<td>2923</td>
<td>38.4</td>
<td></td>
<td>23 (660)</td>
<td>56 (1623)</td>
<td>81 (2358)</td>
</tr>
<tr>
<td>2014</td>
<td>19575</td>
<td>6893</td>
<td>35.2</td>
<td></td>
<td>22 (1485)</td>
<td>63 (4318)</td>
<td>83 (5696)</td>
</tr>
<tr>
<td>2013</td>
<td>18860</td>
<td>5637</td>
<td>29.9</td>
<td></td>
<td>22 (1257)</td>
<td>59 (3302)</td>
<td>79 (4480)</td>
</tr>
<tr>
<td>2012</td>
<td>19968</td>
<td>5372</td>
<td>26.9</td>
<td></td>
<td>24 (1310)</td>
<td>59 (3170)</td>
<td>80 (4316)</td>
</tr>
<tr>
<td>2011</td>
<td>20470</td>
<td>4860</td>
<td>23.7</td>
<td></td>
<td>24 (1143)</td>
<td>57 (2758)</td>
<td>79 (3858)</td>
</tr>
<tr>
<td>2010</td>
<td>19778</td>
<td>4816</td>
<td>24.4</td>
<td></td>
<td>22 (1036)</td>
<td>55 (2628)</td>
<td>78 (3777)</td>
</tr>
<tr>
<td>2009</td>
<td>19251</td>
<td>4558</td>
<td>23.7</td>
<td></td>
<td>20 (922)</td>
<td>50 (2293)</td>
<td>73 (3313)</td>
</tr>
<tr>
<td>2008</td>
<td>21911</td>
<td>4512</td>
<td>20.6</td>
<td></td>
<td>19 (836)</td>
<td>48 (2166)</td>
<td>70 (3154)</td>
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<tr>
<td>2007</td>
<td>24254</td>
<td>4825</td>
<td>19.9</td>
<td></td>
<td>19 (933)</td>
<td>51 (2470)</td>
<td>72 (3493)</td>
</tr>
<tr>
<td>2006</td>
<td>25888</td>
<td>4998</td>
<td>19.3</td>
<td></td>
<td>14 (700)</td>
<td>43 (2131)</td>
<td>67 (3368)</td>
</tr>
<tr>
<td>2005</td>
<td>27890</td>
<td>5236</td>
<td>18.8</td>
<td></td>
<td>13 (686)</td>
<td>43 (2227)</td>
<td>67 (3514)</td>
</tr>
<tr>
<td>2004</td>
<td>29559</td>
<td>6089</td>
<td>20.6</td>
<td></td>
<td>15 (917)</td>
<td>42 (2576)</td>
<td>70 (4289)</td>
</tr>
<tr>
<td>2003</td>
<td>30266</td>
<td>6228</td>
<td>20.6</td>
<td></td>
<td>12 (775)</td>
<td>40 (2475)</td>
<td>71 (4438)</td>
</tr>
<tr>
<td>2002</td>
<td>28730</td>
<td>5900</td>
<td>20.5</td>
<td></td>
<td>10 (569)</td>
<td>34 (2009)</td>
<td>69 (4051)</td>
</tr>
<tr>
<td>2001</td>
<td>24405</td>
<td>4685</td>
<td>19.2</td>
<td></td>
<td>14 (677)</td>
<td>41 (1928)</td>
<td>72 (3369)</td>
</tr>
</tbody>
</table>
Value of Genetics to Farmers

• Annual Genetic Progress

\[
\text{Genetic Gain per Year} = \frac{\text{Genetic Variation } \times \text{ Selection Intensity } \times \text{ Accuracy}}{\text{Generation Interval (Years)}}
\]

– Genetic variation *based on population*
– Selection intensity *should* be improved
– Accuracy of selection *could be* improved
– Generation interval *should* be reduced
Analysis throughout the milk value chain
### TABLE 43
Projected trends in milk consumption from 2000 to 2050

<table>
<thead>
<tr>
<th>Region</th>
<th>Production</th>
<th>Consumption per capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1 000 tonnes p.a.]</td>
<td>[% p.a.]</td>
<td>[% p.a.]</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>16 722</td>
<td>2.6</td>
</tr>
<tr>
<td>Near East/North Africa</td>
<td>29 278</td>
<td>2.3</td>
</tr>
<tr>
<td>Latin America &amp; the Caribbean</td>
<td>58 203</td>
<td>1.9</td>
</tr>
<tr>
<td>South Asia</td>
<td>109 533</td>
<td>2.8</td>
</tr>
<tr>
<td>East Asia</td>
<td>17 652</td>
<td>3.0</td>
</tr>
<tr>
<td>Developing world</td>
<td>231 385</td>
<td>2.5</td>
</tr>
<tr>
<td>World</td>
<td>577 494</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Your way in dairy
We make it happen
ICAR

ICAR (International Committee for Animal Recording)
is the World-Wide Organization for the Standardization of Animal Identification, Recording and Genetic Evaluation
ICAR SubCommittee

- Animal Identification
- Interbull
- Milk Analysis
- Recording Devices
Interbull: the worldwide network providing genetic information services for improvement of livestock
Members of ICAR

2012 (in blue)

Japan
Korea
Taiwan

List of the Countries (in yellow) with at least one Organisation as ICAR Member

2015 (in yellow)
Performance Recording Activities

Minimum Requirements to Ensure a Satisfactory Degree of Uniformity of Recording and Maximum Flexibility in the Choice of Methods

Recording Organization is Free to Determine its Particular Recording Methodology
## Portfolio of Interbull evaluations

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th>Type</th>
<th>Cellcount</th>
<th>Longevity</th>
<th>Calving</th>
<th>Fertility</th>
<th>Workability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>Production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>Production</td>
<td>Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>Production</td>
<td>Type</td>
<td>Cellcount</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>Production</td>
<td>Type</td>
<td>Cellcount</td>
<td>Longevity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Production</td>
<td>Type</td>
<td>Cellcount</td>
<td>Longevity</td>
<td>Calving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Production</td>
<td>Type</td>
<td>Cellcount</td>
<td>Longevity</td>
<td>Calving</td>
<td>Fertility</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>Production</td>
<td>Type</td>
<td>Cellcount</td>
<td>Longevity</td>
<td>Calving</td>
<td>Fertility</td>
<td>Workability</td>
</tr>
</tbody>
</table>

### International information

- **Cross-reference list**
  - Interbull Cross-reference lists of bulls with multiple registrations
  - Production
    - Evaluation summaries for production traits
  - Conformation
    - Evaluation summaries for conformation traits
  - Udder health
    - Evaluation summaries for udder health traits
  - Direct longevity
    - Evaluation summaries for direct longevity traits
  - Calving Traits
    - Evaluation summaries for calving traits
  - Female Fertility
    - Evaluation summaries for female fertility traits
  - Workability
    - Evaluation summaries for milking speed and temperament
ICAR Working Groups

- Milk Recording in Cattle
- Animal Data Exchange
- Genetic Analysis
- Functional Traits
- Milk Recording in Goats
- Developing Countries
Milk quality analysis during milking

Working principle for Herd Navigator for VMS

HN VMS Sampler

Milk sample

Sample intake unit

Analyser

Data processing and user interface

Biomodel feedback for next sample decision
Thanks to high resolution milk flow curves, the quality of the milking routine and milking equipment can be evaluated, for example: (1) lack of pre-stimulation (2) air leakage, (4) overmilking and (5) machine stripping. Furthermore, (6) changes of electrical conductivity in connection with (3) the flow stopping of single quarters, can give additional indications of udder disease.
Genomic Breeding

- DNA extraction
- Markers
- Amplification
- Genetic detection
- Selection

Elite Animal

Livestock samples
Blood, semen, muscle, milk... etc

Genotyping Electrophoresis

Physical map Linkage map

DNA extraction

Agarose gel DNA sequencing

DNA fragments analysis
ACTION Scheme

**Aware** status: to understand what I did and how to do it better.

**Core** facility: to have key tools for building data banks of individual animal.

**Team** ready: to agree the public-private partnership and for a better breeding program.

**In-time** service: to view results of screening for genetic defects in time.

**Outreach** system: to assist a new member what he can use.

**Niche** management: to evaluate the economic value and outcome of each allelic gene.
Core facility to have key tools for building data banks of individual animal.
In-time service

to view results of screening for genetic defects in time.
DNA Test on Frozen Bull Semen

Test Lab.: TAGC-TLRI

Genetic Defects in Cow Reproduction

Complex vertebral malformation (CVM)
Uridine monophosphate synthase (DUMPS)
Bovine leukocyte adhesion deficiency (BLAD)
Citrullinemia (Citr)

Semen sources
USA
Canada
Japan
Holland
Genetic Defects in Reproduction of Cattle and Buffalo

DNA Chip used for Holstein cows:

- Complex vertebral malformation (CVM) 450/4881 CV
- Uridine monophosphate synthase (DUMPS) 4/4881 DP
- Bovine leukocyte adhesion deficiency (BLAD) 104/4881 BL
- Citrullinemia (Citr) 3/4881 CL

Freemartin Test for Cattle & Buffalo

Test Lab.: TAGC-TLRI

Female (non-fertile) with Y chromosome from male sibling

Normal Female

M ♂ ♂ ♂ ♂ M
♀ ♂ ♂ ♂ M
♀ ♂ ♂ M
♀ ♂ M

100 200 300 400

217 280
- Base on Molecular Biology techniques – DNA Typing
- Simultaneously detect 7 mastitis-causing bacteria (3 contagious and 4 environmental bacteria) in 6 hours

**Mastitis in Milk Cow**

<table>
<thead>
<tr>
<th>Strep. agalactiae</th>
<th>Strep. bovis</th>
<th>Strep. dysgalactiae</th>
<th>Strep. uberis</th>
<th>E. coli</th>
<th>Staphyl. aureus</th>
<th>Mysoplasma bovis</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Strep. agalactiae" /></td>
<td><img src="image2.png" alt="Strep. bovis" /></td>
<td><img src="image3.png" alt="Strep. dysgalactiae" /></td>
<td><img src="image4.png" alt="Strep. uberis" /></td>
<td><img src="image5.png" alt="E. coli" /></td>
<td><img src="image6.png" alt="Staphyl. aureus" /></td>
<td><img src="image7.png" alt="Mysoplasma bovis" /></td>
</tr>
</tbody>
</table>
Taiwan Position on Cow Milk Production and Quality of Year 2013

By Ming-Che WU at TLRI 2014/9/16
Conclusion

- Reducing the age of first calving will become a heat-tolerance line in tropical climate.

- Assisted technology is used to ensure top reproductive performance of each herd under manageable feeding and housing system.