The US Dairy Brain Project: Data Integration and Data Applications for Improved Farm Decision-Making

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April 29th, 2021
Current Situation

Dairy data ecosystem

- Sensors
- Milking
- Feed
- DHI
- Genetics
- Processor
- Economics
- Crops, weather...

Complex & Challenging
Publications on Data integration

Data integration

**Is lacking** (Cabrera et al., 2020; Cockburn, 2020; Koltes et al., 2019).

**Improve predicted performance of algorithms when compared with only one data source** (Hogeveen et al., 2010) and **data quality** (Menéndez González et al., 2010).

**Key components to improve data usage and decision making through continuous feedback from farmers** (Cabrera et al., 2020; Dairy Brain, 2020; Eastwood et al., 2017; Etherington et al., 1995).

**Automatized data integration is recognized as a tool to give holistic advice on management practices** (Gengler, 2019).
Using integrated data improves decision making and help a better understanding of the alerts which lead to improved management, welfare and overall sustainability at the farm.

Cabrera and Fadul-Pacheco, 2021.
The Dairy Brain... in brief

- Value-added info accessed at farm via web interface
- Data collected on-farm
- Farm data from multiple sources transferred to a central location
- Data transformed and harmonized
- Analytic services applied

Dairy Brain
Dairy Brain strategy

1. **Create a CIN**
   - A Coordinated Innovation Network to shape the data service development

2. **Create an AgDH**
   - A prototype Agricultural Data Hub to gather and disseminate multiple data streams relevant to dairy operations

3. **Build the Dairy Brain**
   - A suite of analytical modules that leverages the aggregation service and available data to provide insight to the management of dairy operations and services as an exemplar of an ecosystem of connected services

4. **Extension program**
   - Design and execute an innovative Extension program
1. Coordinated Innovation Network (CIN)

“A larger community that addresses bottlenecks... by bringing together experts from different disciplines and domains to identify innovative and synergistic solutions.”
1. Coordinated Innovation Network (CIN)

Network of stakeholders

- Shape the structure and implementation of AgDH and Dairy Brain
- Serve as a basis for broader industry conversations and implementation of services and standards
1. Coordinated Innovation Network (CIN)

Roles of the CIN
- Raise awareness
- Facilitation - exchange opinions and discussion
- Create guidelines
1. CIN: Option Articles

Help us help you make better use of dairy data
Feb. 10 2020
As more and more data is collected on land use, farm operations, animal health, and food supply chains, many initiatives, including the Dairy Brain project at the University of Wisconsin-Madison

Farming out data-driven decisions
March 25 2020
Data has played an integral role in dairy farmers’ decision-making process for many decades. Much of this started with foundational work from land-grant universities and state extension services

Data: Think big, but start small
April 10 2020
Data collection, integration, and analysis are unavoidable factors when it comes to advancing the development of decision support tools in livestock operations
1. CIN: Option Articles

Making data work on the farm
April 25 2020
The University of Wisconsin-Madison Dairy Brain's team is committed to developing data-integrated, data-driven, time-sensitive decision support tools (DST) that disseminate research and help improve...

Creating value from data
May 10 2020
Data is a key driver for improving operations and sustainability of physical and business systems

1. CIN: possible topics design documents

- Data security and chain of custody
- Best practices of data communication and data collection
- Adoption of data-driven decision support tools
- Strategies to monetize data interchange
Roles of the CIN

Raise awareness, facilitation and create guidelines

Survey to learn more about a number of key topics related to data challenges in the dairy industry
2. Create an Agricultural Data Hub
2. Create an Agricultural Data Hub

Data integration steps
1. Assessing
2. Decoding
3. Cleaning
4. Homogenization
5. Integration

Section 17- 17.5 Collecting, integrating, harmonizing and connecting data from dairy farms: The US Dairy Brain Project experience. Victor Cabrera
3. Build the *Dairy Brain*

**Decision Support Tools -DST**

- Descriptive: Dashboard or current situation
- Predictive: Performance projections into the future
- Prescriptive: Optimal management actions

Exemplar of how multiple data sources can be integrated through the AgDH to advanced analytics

Value added
## 3. Build the *Dairy Brain*

<table>
<thead>
<tr>
<th>Decision level</th>
<th>Decision Support Tool</th>
<th>Algorithm</th>
<th>Integrated Data</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational Short-Term (Descriptive)</strong></td>
<td>Daily feed efficiency</td>
<td>Milk / Feed</td>
<td>Milking parlor, DHI, Feed Monitoring</td>
<td>Early warnings</td>
</tr>
<tr>
<td></td>
<td>Daily milk income over feed cost</td>
<td>Milk value / Feed Cost</td>
<td>Parlor, DHI, Feed Monitoring, Milk Processing</td>
<td>Margins controlled</td>
</tr>
<tr>
<td><strong>Tactical Mid-Term (Predictive)</strong></td>
<td>Selection of genetic traits to reduce clinical mastitis</td>
<td>Machine learning</td>
<td>Management, Genetics, Healthier cows and herd</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dynamic net present value of a cow</td>
<td>Markov chains, Time series</td>
<td>All above and below</td>
<td>Best replacement decisions</td>
</tr>
<tr>
<td><strong>Strategic Long-Term (Prescriptive)</strong></td>
<td>Breeding, genetic, and culling decisions</td>
<td>Monte Carlo, Optimization, Machine learning</td>
<td>All above, health and reproductive protocols</td>
<td>Best breeding, genetic, and culling policies</td>
</tr>
<tr>
<td></td>
<td>Continuous nutritional accuracy</td>
<td>Cluster, Nonlinear programming</td>
<td>Management, Feed monitoring, DHI, Parlor</td>
<td>More accurate feeding</td>
</tr>
</tbody>
</table>
4. Extension

Promotion
Facilitation
Demonstrations
DataMoney
Seminars
Webinars
Workshops

Benefits of Data Integration
Appropriate Use of DST

farmers
agents
advisors
industry
4. Extension

Integrated data usage assessment

Know the current status of the data usage in the farm

Personalized data tool(s)  Help with the decision-making progress
Acknowledgments

This project was supported by the Food and Agriculture Cyberinformatics and Tools grant no. 2019-68017-29935/project accession no. 1019780 from the USDA National Institute of Food and Agriculture.
Questions

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