Snap-Shot Assessments of Nutrient Use on Commercial Dairy Farms

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Presentation Outline

* Nutrient use on dairy farms
* General differences between confinement and grazing dairy systems

Presentation Outline

* What is a snap-shot?
* How data is collected
* Data validation
* Usefulness of the information

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Nutrient use on dairy farms

INPUTS
- Feed
- Animals
- Bedding
- Seed
- Fertilizer
- N fixation
- Irrigation
- Precipitation
- Manure

OUTPUTS
- Dairy cows
- Milk
- Manure
- Crops/Pasture
- Soil
- Leaching
- Gaseous
- Runoff

LOSSES
- Soil accumulation
- Gaseous

Gourley et al., 2007

Escalating fertilizer prices

YEAR
- $/ton
- A. Ammonia
- Urea
- N Solution

Escalating feed prices

YEAR
- Soybean meal ($/ton)
- Corn grain ($/bu)

USDA-NASS, 2009

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Unstable and ebbing milk prices (all milk)

$$ \text{per cwt.} $$

YEAR

98 99 00 01 02 03 04 05 06 07 08 09

10

12

14

16

18

20

to Oct. 09

USDA-NASS, 2009

Today’s snap-shot focus

- Snap-shots of feed intake provide the basis for calculating feed use efficiency & nutrient excretions in manure.

- Manure nutrients, combined with producer information on herd and manure management, provide the basis for calculating where, when and how manure nutrients are distributed on dairy farms.

Differences between confinement and grazing call for different snap-shots.

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Feed on confinement dairy farms

Manure management on confinement dairy farms

Manure distribution on a ‘typical’ WI dairy farm

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Feed on grazing dairy farms

Effluent management

What is a snap-shot? How data is collected

http://www.ars.usda.gov/Services/docs.htm?docid=18709

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Usefulness of snap-shots


Three phases of snap-shots

1) Compile information
- Face-to-face interviews
- Feed, milk, manure & soil samples
- Farmer records

2) Analyze & validate data

3) Discuss information with producers

Components of Face-to-Face Interviews

- A well-scripted statement of purpose and expectations
- Questionnaire
  - Producer profile
  - Farm boundaries and fields
  - Herd structure & management
  - Feed practices (rations)
  - Crop rotations
  - Manure management
  - Nutrient management plans

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Today's examples of snap-shot assessments

Wisconsin
• Phosphorus feeding practices
• On Farmers’ Ground: feed, fertilizer, manure, legumes

Australia
• Accounting for Nutrients: feed, fertilizer, manure, legumes and other (lesser) nutrient sources

China
• Feed and manure management, Shandong Province

Phosphorus feeding practices
• 98 randomly selected farms
• Single snap-shot

On Farmers’ Ground
• 54 randomly selected farms
• Multiple snap-shots to capture seasonal differences in nutrient management

Relationship between fecal P and dietary P

- Graphs showing the relationship between fecal P and dietary P with regression equations and R² values

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
### Dietary P impacts manure P and land spreading requirement

<table>
<thead>
<tr>
<th>Dietary-P (%)</th>
<th>Manure-P (lbs/cow/year)</th>
<th>Spreadable Acres (acres/cow/year)</th>
<th>Acres Needed (100 cow dairy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.35</td>
<td>42</td>
<td>1.6</td>
<td>160 (13%)</td>
</tr>
<tr>
<td>0.38</td>
<td>47</td>
<td>1.8</td>
<td>180 (13%)</td>
</tr>
<tr>
<td>0.48</td>
<td>65</td>
<td>2.4</td>
<td>240 (57%)</td>
</tr>
<tr>
<td>0.55</td>
<td>78</td>
<td>2.9</td>
<td>290 (87%)</td>
</tr>
</tbody>
</table>

*Acres required to meet a P-based nutrient management plan. Manure application rate restricted to crop-P removal from an alfalfa, corn, soybean cropping system.

Calculated based on 20,000 lbs milk production.

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### Usefulness of this snap-shot

- 85% of producers overfeed P
- Fecal P good indicator of diet P
- 40% of farms have positive P balance
- Feeding to NRC recommendations would reduce by two-thirds the number of farms in positive P balance

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### OFG: Stratified random sampling

54 confinement dairy farms in Wisconsin

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Feed Nitrogen Use Efficiencies (FNUE)

Milk N secretion (g/cow/d)
Apparent feed N intake (g/cow/d)

54 Wisconsin dairy farms

<table>
<thead>
<tr>
<th>Lactating cows/farm</th>
<th>Milk Production (kg/cow/d)</th>
<th>FNUE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-29</td>
<td>20.0c</td>
<td>18.2c</td>
</tr>
<tr>
<td>30-49</td>
<td>27.4b</td>
<td>24.2b</td>
</tr>
<tr>
<td>50-99</td>
<td>29.7b</td>
<td>26.6b</td>
</tr>
<tr>
<td>100-199</td>
<td>33.1ab</td>
<td>24.3b</td>
</tr>
<tr>
<td>200+</td>
<td>38.7a</td>
<td>32.6a</td>
</tr>
</tbody>
</table>

Milk N : Manure N Ratio

TMR
Use Posilac 25 % increase due to practice

Dairy management impacts on Milk N : Manure N Ratio

54 confinement dairy farms, Wisconsin

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Actual vs. Potential FNUE

• Farm-to-farm comparisons
• Farm-experimental comparisons

![Graph showing actual vs. potential FNUE](image)

Usefulness of this snap-shot

• Farm size, feed and milking technologies impact the relative amounts of milk and manure produced
• On many farms, actual FNUE is much lower than potential FNUE

Snap-shot of manure collection on Wisconsin dairy farms

![Images of tie-stall and free-stall farms](image)

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Regional, housing type and herd class differences in manure collection on Wisconsin dairy farms

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>Mean</th>
<th>Min.-Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
<td>SW</td>
<td>86 b</td>
<td>25-100</td>
</tr>
<tr>
<td></td>
<td>SC</td>
<td>72 a</td>
<td>30-100</td>
</tr>
<tr>
<td></td>
<td>NE</td>
<td>66 a</td>
<td>33-98</td>
</tr>
<tr>
<td>Housing type</td>
<td>Freestall</td>
<td>89 a</td>
<td>53-100</td>
</tr>
<tr>
<td></td>
<td>Stanchion</td>
<td>66 b</td>
<td>53-100</td>
</tr>
<tr>
<td>Herd class</td>
<td>&lt;50 cows</td>
<td>67 c</td>
<td>42-82</td>
</tr>
<tr>
<td></td>
<td>50-99</td>
<td>76 a</td>
<td>40-100</td>
</tr>
<tr>
<td></td>
<td>100-199</td>
<td>95 a</td>
<td>82-100</td>
</tr>
<tr>
<td></td>
<td>200+</td>
<td>100 a</td>
<td>100-100</td>
</tr>
</tbody>
</table>

Uncollected manure on 54 Wisconsin dairy farms

- Manure deposition (kg/ha/y) range:
  - 340 to 5470 for N
  - 80 to 1170 for P

Usefulness of this snap-shot

- There are geographic, farm type and farm size differences in manure collection and spreading practices.
- ‘Hot spots’ where manure goes uncollected should be manure management focus, particularly on small dairy farms in SW region.

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Accounting for Nutrients (Australia)

- 44 purposefully selected dairy farms
- multiple snap-shots

Study of 44 Grazing-based Dairy Farms, Australia

Face-to-Face Interviews

- Establish/confirm farm layout
- Define herd structure and management

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Feed Conversion Efficiency (Pasture systems)

\[
FCE \, (\%) = 100 \times \frac{\text{Milk ME}}{\text{Feed ME}}
\]

N Intake (g/cow/d) = NI\text{p} + NI\text{s}

- NI\text{p} = NI from grazed pasture
- NI\text{s} = NI from supplements

NI\text{p} = DM\text{p} \times N_r

- DM\text{p} (kg/cow/d) = Dry matter intake from pasture
- \( N_r \) (g/kg) = Nutrient concentration in DM\text{p} determined from grab samples

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
A cow’s ME requirement
(the sum of 4 components)

1) \( \text{ME}_{\text{milk}} = \text{Milk} \times \left[ (1.694 \times ((0.386 \times \text{Fat \%}) \right. \\
\left. + 0.205 \times ((5.8+\text{Protein \%})-0.236)) \right] \)

Parameters based on body weight (x)

2) \( \text{ME}_{\text{walking}} = \text{kms} \times (0.0037x - 0.0007) \)
3) \( \text{ME}_{\text{grazing}} = 0.1063x + 19.533 \)
4) \( \text{ME}_{\text{maintenance}} = 0.0915x + 8.1803 \)

CSIRO, 2004

\begin{align*}
\text{NIs} &= \text{DMI} \times \text{Ns} \\
\text{DMI} \text{ (kg/cow/d)} &= \text{Suppl. fed, defined by producers} \\
\text{Ns} \text{ (g/kg)} &= \text{Nutrient concentration in supplement samples}
\end{align*}

Relationship between grain fed and milk production
Grazing farm in Australia

\[ y = 2.382x + 12.446 \]
\[ R^2 = 0.7387 \]

Approximately 2.4 liters of milk obtained per kg of grain fed

Powell and Aarons, unpubl.

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
The efficiency with which grain CP was transformed into milk CP diminishes as grain CP exceeds approx. 15% of the total dietary CP intake.

Powell and Aarons, unpubl.

**Snap-shot of manure collection on pasture-based dairy farms**

- 1. Captured manure
- 2. Manure on non-productive areas
- 3. Manure on productive areas

The archived presentation is available at: http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
How good is snap-shot data?

- Feed nutrient consumption
- Milk production and nutrient secretion
- Manure nutrient excretion

Assess biological feasibility of the snap-shot data

Assess biological feasibility of snap-shot data

1) **Cow N balance (CNB)**

\[
\text{CNB (g N cow/d)} = \text{Feed N intake} - \text{Milk N} - \text{Manure N}
\]

2) **Equilibrium feed requirement (EFR)**

(the relative amount of additional, or less DMI required to achieve CNB of zero)

\[
\text{EFR (% of DMI)} = 100\times(\text{CNB/DMN})/\text{DMI}
\]

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
### Apparent daily feed nitrogen (N) intake, outputs, cow N balance (CNB) and equilibrium feed requirement (EFR)

<table>
<thead>
<tr>
<th>Location</th>
<th>Feed N</th>
<th>Milk</th>
<th>Manure</th>
<th>CNB (%)</th>
<th>EFR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shandong, Farm 1</td>
<td>438</td>
<td>98</td>
<td>328</td>
<td>+12</td>
<td>-2.7</td>
</tr>
<tr>
<td>Shandong, Farm 2</td>
<td>537</td>
<td>135</td>
<td>383</td>
<td>+19</td>
<td>-3.5</td>
</tr>
<tr>
<td>Wisconsin, forty-one</td>
<td>635(135)*</td>
<td>152 (35)</td>
<td>457 (71)</td>
<td>-27 (59)</td>
<td>-2.5</td>
</tr>
</tbody>
</table>

* Mean, standard deviation in parenthesis

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### Comparison of literature estimates of ExN and difference between feed N intake (FNI) and milk N (MN)

**Confinement dairy farms**

\[
\text{ExN (g/cow/d)} = (\text{DMI x DMN x 84.1}) + \text{BW x 0.196} \\
\text{(Nennich et al., 2005)}
\]

**Graph**

- ExN = Feed N intake
- MN = Milk N
- Slope = 1
- x = y

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### How good is snap-shot data?

- **Manure spreading**
  - Compare estimates from (1) farmer information on manure collection, (2) manure spreading records

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**INTRODUCTION**

Section 1  
How to use the manure spreading book

Section 2  
Farm maps

Section 3  
Manure record sheets

Section 4  
How to sample manure

---

**Comparison of snap-shot estimates of manure P applications to cropland**

- **Manure collection**  
- **Manure spreading book**

<table>
<thead>
<tr>
<th>Manure P Application (kg ha⁻¹)</th>
<th>Free-stalls</th>
<th>Stanchions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of annual crop P removal on Wisconsin dairy farms</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Total Manured Land:**  
240 acres (88%)

The archived presentation is available at:  
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Livestock and Poultry Environmental Learning Center Webcast Series

November 20, 2009

The archived presentation is available at:
http://www.extension.org/pages/Snap-Shot_Assessments_of_Nutrient_Use_on_Dairy_Farms_Webcast
Total Land Affected by Buffer:
165 acres (60.5%)

Land manured during Winter:
59 acres

590 Standard

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Winter manured land affected by buffer: 37 acres (61%)
Thanks For Your Attention!

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