Can you help me?

Nutrient balance and management issues on NE dairy farms
Context

• CAFO Regs
  – closer link b/t application rate and crop need
  – risk assessment

• NYS water quality standards
  – visual impact can result in fines
  – can our guidelines prevent runoff/leaching?

• Ammonia emissions
  – barns as point sources?
  – “fugitive” NH-4 from spreading?

• Message to the field: apply less nutrients
  – need to look at current feasibility
Back of the envelope dairy calculations

• Cow eats 45# feed DRY MATTER per day
  Of the 45# feed DM:
    – 50/50 concentrate/forage ratio
• 22.5# forage DM/day x 365 = 8200#
• 8200# DM + losses + supply buffer
• ~5 tons of DM from forage crops/cow
• ~1 acre/mature cow with average crop yields- 5.25 t/a DM corn silage (~1.5 AU/A, 1AU=1,000#)
• ~1 acre/cow plus her replacement with very good to excellent crop yields: 7.7 t/a DM corn silage (~2 AU/A)
• This is how NE dairies are organized today!
M/N Balance (as affected by concentrate purchases):

<table>
<thead>
<tr>
<th>Size of dairy farm</th>
<th>45</th>
<th>320</th>
<th>500</th>
</tr>
</thead>
<tbody>
<tr>
<td>--tons of p/yr--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INPUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>purchased fertilizer</td>
<td>1.2</td>
<td>2.0</td>
<td>10.0</td>
</tr>
<tr>
<td>purchased feed</td>
<td>1.0</td>
<td>8.4</td>
<td>14.2</td>
</tr>
<tr>
<td>purchased animal</td>
<td>0.0</td>
<td>0.03</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td>10.4</td>
<td>24.2</td>
</tr>
<tr>
<td>OUTPUT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>milk</td>
<td>0.36</td>
<td>3.8</td>
<td>5.5</td>
</tr>
<tr>
<td>animals sold</td>
<td>0.05</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>crops sold</td>
<td>0.02</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>0.43</td>
<td>4.3</td>
<td>6.0</td>
</tr>
<tr>
<td>REMAINDER</td>
<td>1.8</td>
<td>6.2</td>
<td>18.2</td>
</tr>
<tr>
<td>% ~ excreted as manure, not milk</td>
<td>81%</td>
<td>59%</td>
<td>75%</td>
</tr>
</tbody>
</table>

(Klausner)
Let’s take a look at....

- Cow excretes ~10% BW/day as manure
- 1400# cow excretes 25 tons per year (~1.5 AU)
  cow + replacement = 36 tons per year (~2 AU)
- Manure samples from storage: 10# N and 4# P2O5/ton
- If VG management= 2 AU/A, then there is 360#N and 144# P2O5/A/year to spread!
[cncps: ~400 N, 130 P2O5 per cow as excreted (van Amburgh)]

agronomic guidelines:
  Balance management choices and the environment?

Utilization:
  1/4-1/2 N- ammonia conservation??
  P- 2x crop removal annually?
  N fixation via legumes??
NYS soil test P over time:

(Ketterings and Kahabka)
Air

• Concern:
  – air emissions of NH4
  – Odor/neighbor relations

• Solution:
  – Incorporate manure

• Challenge:
  – Fall incorporation?
  – Farm N balance the same?
Surface Water

- **Concern**
  - P runoff

- **Solution**
  - Storage/Timing
  - Incorporation
  - Farther from water

- **Challenge**
  - Soil erosion?
  - Groundwater?
  - Impact of intense spreading at various scales?
Groundwater/wells

- **Concern:**
  - N leaching
- **Solution:**
  - Surface application
  - Reduced rates
  - Timing/storage
- **Challenge**
  - Air emissions/odors
  - Individual wells vs aquifer

- Preble
- Batavia
- Letchworth
**NO$_3$–N Leaching from manure applications on corn (ppm):**

<table>
<thead>
<tr>
<th>Timing</th>
<th>Loamy Sand</th>
<th>Clay Loam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early fall</td>
<td>22.4</td>
<td>15.4</td>
</tr>
<tr>
<td>Late fall</td>
<td>19.3</td>
<td>11.8</td>
</tr>
<tr>
<td>Early spring</td>
<td>11.8</td>
<td>6.2</td>
</tr>
<tr>
<td>E. spring + sidedress</td>
<td>12.6</td>
<td>7.2</td>
</tr>
</tbody>
</table>

(van Es)
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<th>Clay Loam</th>
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</thead>
<tbody>
<tr>
<td>Early fall</td>
<td>2.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Early spring</td>
<td>2.1</td>
<td>1.6</td>
</tr>
<tr>
<td>N fertilizer</td>
<td>6.3</td>
<td>2.1</td>
</tr>
</tbody>
</table>

(van Es)
Can we achieve a balance??

What is feasible based on the biology and management?

Can we develop (more) sustainable livestock agriculture production systems for the NE??
Solutions??

- Risk indices
- Source reduction – precision feeding and forage
- What on farm reductions are possible/practical??
- Treatment/export?
  - Driven based on biological limitations?
Discussion?
Steps to take??