NUTRIENT CYCLING ON WISCONSIN DAIRY FARMS: THE ON FARMERS’ GROUND PROJECT

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Overview

- On farmers ground - the ‘big picture’
  - What's the study all about?
  - What data are we collecting?
  - How did we collect it?

- Focus on 'Manure gap'
  - Continuation of Heathers work (Saam, 2004)
  - Reasons for ‘Manure gap’ - *preliminary results*

- On going research
The unintentional loss of nutrients such as nitrogen (N) and phosphorous (P) from the farm to the environment are pressing problems facing the WI dairy industry.

In the future, the sustainability of all dairy farms will increasingly depend not only on profitable milk production, but also on farmers' ability to meet nutrient management regulations.

To successfully accomplish the goals of these new nutrient management regulations it is essential that farmers are prepared to implement them.

Increased input from farmers on this issue is therefore desirable, not only to identify barriers but also opportunities for improving nutrient use on Wisconsin dairy farms.
On Farmers’ Ground (OFG) project was initiated in 2002 to expand our understanding of the ways farmers in Wisconsin currently manage farm nutrients.

By working closely with farmers we hope to identify how their nutrient management challenges are influenced by factors such as:

- Farm geographic location,
- Soil type,
- Animal stocking density,
- Farmer behavioral factors.
Nutrient management data was collected from all 54 farms through a structured, face-to-face on-farm survey. Information collected included:

- General farm characteristics
  - e.g. herd size, housing facilities.

- Cropping practices
  - e.g. acres operated, crops planted, fertilizer inputs

- Dairy herd feeding practices
  - e.g. current feeding rations, sources of feed information

- Manure management practices
  - e.g. manure collection, storage, and spreading practices
Data Collection (survey)

- This data is being used in conjunction with various nutrient cycling models such as, the Dairy Forage System Model (DAFOSYM, Rotz, 1989) to compare how each farm's current nutrient management practices affect issues such as:

  - Whole farm nutrient balance of
    - Phosphorous (P),
    - Nitrogen (N)
    - Potassium (K)

  - Specific management issues such as the risk of:
    - P loss
    - Ammonia volatilization
    - Nitrate leaching
Preliminary results- Manure Gap between regions

- Saam (2003) conclusions:
  - Need to recognize that animal density is likely to be an issue in implementing nutrient management standards
  - Total and Tilled Animal land rations estimates are conservative
  - Actual “Manured” animal land rations estimates indicate a large, and regionally variant manure gap
    - i.e. the North east farms only use 27% of total cropland to spread manure whereas South west farms use 44%
Manure Gap between regions

- Do OFG farms also show this regional ‘Manure Gap’ discrepancy?
### Manure Gap between regions

<table>
<thead>
<tr>
<th>Animal density indicator</th>
<th>Southwest</th>
<th>Southcentral</th>
<th>Northeast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Units / Total Cropland (ACLR)</td>
<td>Low8 60</td>
<td>61</td>
<td>72.2</td>
</tr>
<tr>
<td></td>
<td>Medium8 26.7</td>
<td>39</td>
<td>27.8</td>
</tr>
<tr>
<td></td>
<td>High8 13.3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Animal Units / Manured Cropland (AMLR)</td>
<td>Low8 0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Medium8 27</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>High8 73</td>
<td>78</td>
<td>83</td>
</tr>
</tbody>
</table>

- Theoretically, the Northeast region has the lowest number of animals per acre of total cropland.
- However, actual acres of cropland used spread indicates it is using the lowest % of available cropland to spread manure.

Where:
- Low = 8 < 0.75 AU/Acre
- Medium = 8 0.75 - 1.5 AU/Acre
- High = 8 > 1.5 AU/Acre
Manure Gap between regions

- What are the reasons for the ‘manure gap’?
  1. Between regions
  2. All farms

- What factors affect where and when farmers spread manure?
Table 1. Manure storage and hauling frequencies of dairy farms from the southwest, southcentral and northeastern regions of Wisconsin.

<table>
<thead>
<tr>
<th>Manure Storage</th>
<th>Southwest†</th>
<th>Southcentral‡</th>
<th>Northeast†</th>
<th>Average‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farms with manure storage (%)</td>
<td>38.9</td>
<td>50.0</td>
<td>61.1</td>
<td>50.0</td>
</tr>
<tr>
<td>Mean days of storage</td>
<td>94</td>
<td>243</td>
<td>373</td>
<td>284</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hauling frequencies</th>
<th>Southwest†</th>
<th>Southcentral‡</th>
<th>Northeast†</th>
<th>Average‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haul daily year round (%)</td>
<td>88.2</td>
<td>88.2</td>
<td>77.7</td>
<td>84.6</td>
</tr>
<tr>
<td>Haul daily year round except summer (%)</td>
<td>0.0</td>
<td>5.9</td>
<td>11.1</td>
<td>5.8</td>
</tr>
<tr>
<td>Haul daily year round except winter (%)</td>
<td>5.9</td>
<td>0.0</td>
<td>0.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Haul in spring and fall only (%)</td>
<td>5.9</td>
<td>5.9</td>
<td>5.6</td>
<td>5.8</td>
</tr>
<tr>
<td>Haul in fall only (%)</td>
<td>0.0</td>
<td>0.0</td>
<td>5.6</td>
<td>1.9</td>
</tr>
</tbody>
</table>

- Storage – NE region has greatest frequency of farms with storage. It might be expected that greater storage allows more ‘timely’ applications of manure.

- However the majority of farms from all regions still haul manure year round.
Table 2. Factors influencing when and where manure is hauled (% important) on dairy farms from the southwest, southcentral and northeastern regions of Wisconsin.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Southwest†</th>
<th>Southcentral†</th>
<th>Northeast†</th>
<th>Average‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop requirements</td>
<td>71.4</td>
<td>88.9</td>
<td>100.0</td>
<td>90.7</td>
</tr>
<tr>
<td>Soil conditions</td>
<td>85.7</td>
<td>77.8</td>
<td>83.3</td>
<td>81.4</td>
</tr>
<tr>
<td>Soil residual nutrient levels</td>
<td>57.2</td>
<td>83.3</td>
<td>66.6</td>
<td>72.1</td>
</tr>
<tr>
<td>Weather conditions</td>
<td>57.2</td>
<td>61.1</td>
<td>66.6</td>
<td>62.8</td>
</tr>
<tr>
<td>Hauling distance</td>
<td>28.6</td>
<td>27.8</td>
<td>22.3</td>
<td>25.6</td>
</tr>
<tr>
<td>How full manure storage is</td>
<td>66.6</td>
<td>44.4</td>
<td>63.7</td>
<td>56.5</td>
</tr>
<tr>
<td>(for farms having storage)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability of custom hauler</td>
<td>33.3</td>
<td>12.5</td>
<td>50.0</td>
<td>29.4</td>
</tr>
<tr>
<td>(for farms using custom haulers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Little differences in most other factors that regions regard as important when deciding when and where they spread manure

- Hauling distance NOT as important as other factors

- Availability of custom haulers is more important in the NE region than any other
Low importance of hauling distance for the Northeast region was surprising as generally farms are more spread out than other regions due to developmental pressures.
- Difficult to get land near home farm
  - Farm more disaggregated

- So why distance not more important?
- Problems with questions?
  - Focus on fields they know they spread on

- To clarify these issues and further understand manure spreading behavior, each of the OFG farmers are currently participating in a manure tracking study
Manure tracking

- Manure books constructed for each farm using digitized farm maps
- Each farmer is tracking manure hauling practices for 1 year noting:
  - Location
  - Quantity
  - Type
  - Factors affecting spreading
Example of manure tracking records
Manure Gap between regions

- What are the reasons for these differences?
  1. Between regions
  2. All farms

- Why do the majority (73%) of farms ‘appear’ to be applying manure above N & P ‘guidelines’?

- Slight error in the calculation?
  - Assumes all manure is collected and spread!

UNLIKELY TO BE TRUE – outside areas
Outside Manure Deposition
Adjacent to barn
Outside Manure Deposition
Feed bunk areas
Apparent Manure Collection

- Apparent manure collected was calculated according to the following summarized equation:

\[
\text{\% Apparent Manure Collected} = \frac{\text{Total manure excretion} \times (1 - \text{manure not collected})}{\text{Manure not collected} \times \frac{\text{hours spent by herd in outside areas not scraped}}{24}}
\]

*calculated on a seasonal basis

*NB season length was not consistent and corrected according to farmers perception
Apparent Manure Collection

Lactating cows only (n =18)

<table>
<thead>
<tr>
<th>Region</th>
<th>Farms that do NOT collect all manure</th>
<th>Manure collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>South West region</td>
<td>72%</td>
<td>64%</td>
</tr>
<tr>
<td>South Central region</td>
<td>89%</td>
<td>64%</td>
</tr>
<tr>
<td>North East region</td>
<td>61%</td>
<td>66%</td>
</tr>
</tbody>
</table>
The majority of dairy farms do not collect all manure.

Calculated manure loading rates may be much higher than actual manure loading rates.

Potential nutrient buildup in outside areas where manure not collected.

Regional differences between manure gap not yet realized.
Future work ‘Manure Gap’

- Process Manure tracking book data

- Calculate annual manure (N, P and K) loading rates in outside areas and application to cropland
  - Measure surface area of each (GPS)

- Evaluate manure management strategies for outside areas
OFG - On going and future work

- Tip of the iceberg!!!!!

- Nutrient management data analysis
  - Modeling and comparing nutrient flows for different farms/regions
OFG - On going and future work

- Final Phase - feedback
  - Share compiled and individual study results with farmers and possibly make nutrient balancing recommendations
  - Determine how and why certain nutrient management decisions were made
  - Identify barriers they perceive to nutrient management/recommendations
    - Difficulty in tracking manure spreading
    - Mass balance approach
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