Managing Nutrients in Manitoba’s Livestock Industry

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Hog Production Industry Review
April 18, 2007
Outline

- Personal Background
- History
- Nutrient Management
  - Manure Application
  - Regulations
    - Nitrogen
    - Phosphorus
- Conclusions and Future Directions
Personal Background

• Farming Background
  – mixed grain, oilseed and potato operation
  – Livestock 3 year rotation of manure
• Personal On-Farm Experience (early 90’s)
  – soil and water management issues
  – government, research and other parties
• Environmental Issues
  – Industrial Waste Water
  – Hog Industry
History

• Pork Industry in Manitoba

• Trade-offs
  – Economic Growth versus Environmental Sustainability
  – Competing Interests
    • Hog Producers versus Environmentalists
    • Government Departments

• Crossroads for Livestock Industry
Nutrient Management
Manure Application

Manure – Natural Fertilizer

Source of Essential Nutrients

– Nitrogen (N)
– Phosphorus (P)
– Others such as potassium (K), sulphur (S), etc.

Balance of Nutrients

– Manure Content vs Crop Requirements
Residual Phosphorus - 1 Year of Hog Manure Application
Spring Wheat (40 bu/ac)

- Hog Manure: 63 lbs/acre (85% N, 15% P)
- Spring Wheat: 32 lbs/acre (85% N, 15% P)
- Residual Phosphorus: 31 lbs/acre

Nutrient Management
Manure Application
Nutrient Management
Manure Application

Residual Phosphorus - 10 year Wheat/Canola Rotation

- Hog Manure - 10 years
  - Phosphorous (P): 671 lbs/acre
  - Nitrogen (N): 985 lbs/acre

- Total (Wheat + Canola)
  - Phosphorous (P): 450 lbs/acre
  - Nitrogen (N): 985 lbs/acre

- Total Residual Phosphorus: 221 lbs/acre
Nutrient Management
Manure Application

1994 – Guidelines for Manitoba Hog Producers

• Land Base Requirement
  – What is an animal unit (AU)?
  – manure generating 73 kg or 160 lbs nitrogen (N)

<table>
<thead>
<tr>
<th>TABLE 18: LAND BASE REQUIRED FOR MANURE APPLICATION, ACRES</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEP 1: Number of Livestock</td>
</tr>
<tr>
<td>Animal Unit Factor (Table 17)</td>
</tr>
<tr>
<td>Total Animal Units (A \times B)</td>
</tr>
<tr>
<td>STEP 2: Storage and Application Factor (Table 15)</td>
</tr>
<tr>
<td>STEP 3: Soil and Crop Nitrogen Utilization Factor (Table 16)</td>
</tr>
<tr>
<td>STEP 4: Days in Feeding Location</td>
</tr>
<tr>
<td>STEP 5: Acres Required for Feeding Location</td>
</tr>
<tr>
<td>(C \times D \times E \times F / 365)</td>
</tr>
</tbody>
</table>

1998 Guidelines for MB Hog Producers
Nutrient Management
Manure Application (N-based)

• **1994** – maximum application rates recommended:
  – Medium to heavy soils 90 lb/acre
  – Light soils 70 lb/acre

• **1997** – max application rates increased:
  – Medium to heavy soils Max 140 lb N / acre (top 4 ft)
  – Light soils Max 90 lb N / acre (top 4 ft)
  – Alfalfa Max 275 lb N / acre (top 4 ft)

• **1998** (Regulation no 42/98)
  – Same rates as 1997, but reduced soil sampling depth to top 2 ft

• **2004** – max application rates based on soil classes
  – *i.e. Soil Class 1,2,3 ("capable of sustained production of common field crops") – allowed 140 lb N/acre in top 2 ft x 2, or 280 lb/N/acre during growing season*
Nutrient Management
Manure Application (P)

• **Different terms / units of measurement**
  – ppm, P (elemental Phosphorous), & P$_2$O$_5$ (phosphate)
  – “Soil Test P” is measured using the “Olsen method”

• **Multiple terms cause confusion**
  – Ensure calculations and rates are “comparing apples to apples”
  – i.e. 10 ppm = 20 P = 46 P$_2$O$_5$
# Nutrient Management

## P Agronomics vs Manure Application Regulations

### Agronomic Recommendations for P

<table>
<thead>
<tr>
<th>Soil Test P</th>
<th>Rating</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>20+ ppm</td>
<td>Very high</td>
<td>0 to 10 P$_2$O$_5$ / acre for cereals, max 25 P$_2$O$_5$ for legume</td>
</tr>
</tbody>
</table>

### Manure Management Recommendations for P (effective Jan, 2006)

<table>
<thead>
<tr>
<th>Soil Test P</th>
<th>Rating</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;60 ppm</td>
<td>low risk</td>
<td>no limit based on P content</td>
</tr>
<tr>
<td>60 - 119 ppm</td>
<td>medium risk</td>
<td>2 x crop removal rate of P is allowed</td>
</tr>
<tr>
<td>120 - 180 ppm</td>
<td>high risk</td>
<td>1 x crop removal rate of P is allowed</td>
</tr>
</tbody>
</table>
Crossroads for Manitoba’s Hog Industry

1. In summary, changes to regulations have allowed for increasing amounts of residual nitrogen (N)
2. However, the phosphorus (P) content of manure has recently become a major concern
3. Has the push for economic growth via Manitoba’s hog industry compromised the environment, and at what cost?
4. Can we restore balance between economic growth and environmental sustainability?
Nutrient Management
Dealing with the Phosphorus Content of Manure

Manitoba Sources of Phosphorous to Lake Winnipeg (tonnes/yr)
Source: Lake Winnipeg Stewardship Board - Interim Report, January 2005
Nutrient Management
Dealing with the Phosphorus Content of Manure

• In certain scenarios, managing manure based on nitrogen (N) content has resulted in elevated levels of soil phosphorus (P)
• Managing manure as a fertilizer, taking into consideration the P utilization of crops, is a more sustainable practice

“By strict regulation, manure can only be applied to the land as fertilizer.”
i.e. Applied manure application rates should not exceed crop removal rates

SOURCE: (The Truth Matters, MPC Advertisement, June 2002)
## Nutrient Management

### Dealing with the Phosphorus Content of Manure

#### Appendix Table 12. Phosphorus recommendations for field crops based on soil test levels and placement.

<table>
<thead>
<tr>
<th>Soil phosphorus (sodium bicarbonate P test) ppm</th>
<th>Cereal</th>
<th>Corn</th>
<th>Sunflower</th>
<th>Canola</th>
<th>Mustard</th>
<th>Buckwheat</th>
<th>Faba beans</th>
<th>Flax</th>
<th>Peas</th>
<th>Field beans</th>
<th>Lentils</th>
<th>Legume forages</th>
<th>Perennial grass forages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S1</td>
<td>S2</td>
<td>Sb1</td>
<td>BP</td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>S1</td>
<td>B1</td>
<td>S1</td>
<td>B1</td>
<td>P1</td>
<td>P1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>VL</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
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<td>40</td>
<td>40</td>
<td>40</td>
<td>75</td>
<td>75</td>
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<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td>VL</td>
<td>35</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>75</td>
<td>75</td>
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<tr>
<td>10</td>
<td>10</td>
<td>10</td>
<td>L</td>
<td>30</td>
<td>35</td>
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<td>35</td>
<td>30</td>
<td>35</td>
<td>30</td>
<td>35</td>
<td>75</td>
<td>75</td>
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<tr>
<td>15</td>
<td>15</td>
<td>15</td>
<td>M</td>
<td>25</td>
<td>30</td>
<td>30</td>
<td>30</td>
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<td>30</td>
<td>30</td>
<td>30</td>
<td>75</td>
<td>75</td>
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<td>20</td>
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<td>20</td>
<td>25</td>
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<td>25</td>
<td>20</td>
<td>25</td>
<td>20</td>
<td>20</td>
<td>75</td>
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<tr>
<td>20+</td>
<td>40</td>
<td>40</td>
<td>VH</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>75</td>
<td>75</td>
</tr>
</tbody>
</table>

- **S1**: seed placed rates
- **Sb2**: side banded rates for row crops
- **B3**: banded away from the seed
- **PPH4**: for forages phosphorus is applied most effectively by banding 1 inch to the side and below the seed. If phosphorus cannot be banded, then broadcast and preplant incorporate.
- **B75**: broadcast for established stands of forages
- **Est stand**: established stands of forages

Impact of “Soil Test P” on Phosphorous Loading Risk to Lake Winnipeg

- High soil test P values are common in fields fertilized with hog manure
- As soil test P increases, the risk of phosphorous loading to surface water increases at the same rate.
- This relationship can be illustrated by using phosphorous source data presented by the Lake Winnipeg Stewardship Board – Interim Report, January 2005.
- It is possible to isolate the average level of P loading per acre based on different starting soil test P values...
Soil Test P and P Contribution to Lake Winnipeg, Manitob Hog Industry, Revised Data
Soil Test P and P Contributions to Lake Winnipeg, Manitoba Hog Industry

% P Contribution to Total

- % of Total P load to Lake Wpg (all sources)
- % of Total P load to Lake Wpg (all MB sources)
- % of Total P Load to Lake Wpg (MB agricultural sources)

Soil Test P

15 ppm  60 ppm  120 ppm  180 ppm
2006 Hog Industry Facts & Assumptions
(As stated by MPC in a presentation posted on their website “The Hog Industry in Manitoba”)

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonnes Excreted (2006)</td>
<td>29,847</td>
<td>10,995</td>
</tr>
<tr>
<td>Estimated Average Crop Removal Rate</td>
<td>99.5 kg/ha/yr</td>
<td>15 kg/ha/yr</td>
</tr>
<tr>
<td>Crop land area required to recycle nutrients excreted</td>
<td>300,000</td>
<td>744,000</td>
</tr>
</tbody>
</table>

- MPC requires 2.44 times more land area, or an additional 444,000 ha, to sustainably manage phosphorous
  - inputs cannot exceed crop removal rates
  - science-based crop removal calculations ignored until now.
SUMMARY

1) MB Hog Industry – Unsustainable Manure Management
   • 10-15 years
   • N-based application rates lead to P accumulation

2) Lake Winnipeg – Phosphorus Loading
   • P-loading will increase under current management practices

3) Environment versus Economics
   • Land base to manage nutrients (N and P) in a sustainable agronomic manner
   • Pressure from Hog Industry to compromise
     – Economics of manure management - the “waste bucket” approach
     – Environmental stewardship and the protection of MB water
Effectiveness of MB Manure Management Regulations

• Regulations - incentives used to motivate compliance
  – rewards, penalties, monitoring and enforcement

• Saying that MB regulations are amongst the most strict in the world…DOES NOT MAKE THEM SUSTAINABLE!

• Low level fines and deterrents facilitate pollution
  – More often than not, farm economics dictate producer’s behaviour
  – commitment to environmental stewardship

• From 1998/99 to 2005/06, MB Livestock Manure & Mortalities Management Regulation reported:
  – 115 prosecutions and 398 warnings
  – Only $129,579 in fines collected
Livestock Manure & Mortalities Management Regulation

Summary Enforcement Activities 1998/99 to 2005/06

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Prosecutions</th>
<th>Warnings</th>
<th>Orders</th>
<th>Fines ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998-99</td>
<td>12</td>
<td>32</td>
<td>7</td>
<td>11,862.</td>
</tr>
<tr>
<td>1999-00</td>
<td>9</td>
<td>35</td>
<td>10</td>
<td>8,496.</td>
</tr>
<tr>
<td>2000-01</td>
<td>16</td>
<td>49</td>
<td>22</td>
<td>8,067.</td>
</tr>
<tr>
<td>2001-02</td>
<td>16</td>
<td>53</td>
<td>34</td>
<td>11,903.</td>
</tr>
<tr>
<td>2002-03</td>
<td>15</td>
<td>59</td>
<td>21</td>
<td>20,280.</td>
</tr>
<tr>
<td>2003-04</td>
<td>19</td>
<td>54</td>
<td>57</td>
<td>23,076.</td>
</tr>
<tr>
<td>2004-05</td>
<td>16</td>
<td>63</td>
<td>45</td>
<td>36,960.</td>
</tr>
<tr>
<td>2005-06</td>
<td>12</td>
<td>53</td>
<td>35</td>
<td>8,935.</td>
</tr>
<tr>
<td>TOTALS</td>
<td>115</td>
<td>398</td>
<td>231</td>
<td>129,579.</td>
</tr>
</tbody>
</table>

Average fine per violation:
= $129,579 Total fines collected / 115 prosecutions = $1,127 per prosecution

Conclusions

1. Manitoba’s hog industry needs to operate in an environmentally sustainable manner

2. Current manure management regulations do not represent a sustainable benchmark.

3. For science-based manure management regulations, MB’s hog industry must not condone application rates that exceed the crop removal rate of N, P, and other nutrients.

4. Ineffective monitoring and enforcement of manure application regulations has contributed to current problems in MB’s hog industry
FUTURE DIRECTIONS

• Nutrient Thresholds must be based on:
  – ability of crops to use nutrients
  – consider residual nutrients applied in previous years
  – **NOT** holding capacity of soil

• Conduct field testing and publicize results on an ongoing basis
  – acquire funding to assess and monitor P transport risks throughout the province
  – ensure accountability of regulators and producers
FUTURE DIRECTIONS

• Land base
  – Hog industry requires 2.44 times the area currently used
    • stop P accumulation of MB soils
    • prevent P loading of MB water resources.

• Lesson learned - take things slow
  – ambitious growth contributed to the current situation
  – ignored the science of P recycling rates; crop recycling of P

• Maintain a proactive approach