Phosphorus Reduction Through Precision Animal Feeding

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Phosphorus in the Cannonsville: What is Delaware County Doing About it?
The Delaware County Action Plan for Phosphorus Reduction (DCAP)
DCAP Origins

- Regs - Basin is “P” restricted
- Economic growth restricted
- Variance for WWTP expansion
- Regs - Comprehensive Strategy DCAP
- BoS implement DCAP/ part of solution
  - Commitment $2 million +, $2 million + in grants
  - Local governance
DCAP Tenets

• Voluntary with incentives
• Locally administered
• Collaborative/partnerships
• Scientific base
• Supports decisions on the land
• Useful outside the NYC watershed
DCAP Goals

• Short Term
  ➢ Obtain “P” Offsets – WWTP expansions
  ➢ Implement integrated research conjunctively w/ management practices

• Long Term
  ➢ Sustain water quality mgm’t program
  ➢ Increase local capacity for decision making
  ➢ Removal from “P” restriction
  ➢ Continue “P” reduction to avoid future TMDLs or lower guidance values - $ Margin of Safety
Cannonsville Reservoir NPS Phosphorus Load

- Forest: 25%
- Urban: 3%
- Septics: 3%
- Active & Inactive Agriculture: 69%

Bishop, 2001
Whole Farm Phosphorus Mass Balance

Imported P

Farm Boundary

Exported P

Feed

Fertilizer

Bedding

Animals

P remaining on farm

Run off

Leaching

P Losses to water

Milk

Crops

Animals

Manure
Impact of Feed P imports

- 18 - 41 kg Feed P imported per cow/year
- 7000 – 8000 mature cows in Cannonsville Reservoir Basin
- = 126,000 – 328,000 kg P imported into Basin per year as feed
- 50,000 kg avg. annual P loading to the Cannonsville Reservoir
The Phosphorus Reduction Through Precision Animal Feeding Program

- Developed as part of Delaware County’s Comprehensive Strategy to address phosphorus management (Delaware County Action Plan - DCAP)
The Phosphorus Reduction Through Precision Animal Feeding Program

- One of several Ag and non Ag strategies
  - Manure composting and export
  - Urban storm water management
  - On site septic systems
  - Rural road runoff management
  - Modeling and monitoring
Simplified Phosphorus Cycle of the Dairy Farm

- Purchased Feed
- Crops
- Manure
- Soils
- Cow
- Milk
- Farm boundary

Intervene
Phosphorus Reductions Through Feed Management

Precision Feed Management

Precision Feeding <-> Comprehensive Forage Management
The Phosphorus Reduction Through Precision Animal Feeding Program

Designed to:

- Assess potential to reduce phosphorus imports and manure excretions on typical dairy farms through precision feed management

- seek to realize this potential
Precision Animal Feeding Program – Project 1

- 2 years
- 4 farms (2 monitor, 2 implement)
- work closely with farmers and feed reps
- feed industry outreach
Precision Animal Feeding Program – Project 1

- **Procedures:**
  - Gathering data 1x per month (milk production test day)
    - Feed quality analysis
    - Measuring feed intakes
    - Monitoring milk production
    - Monitoring animal and environmental parameters
Precision Animal Feeding Program – Project 1

Procedures:

- Summarizing data by milk level for the milking herd:
  - < 50 lbs/d  50-70 lbs/d  70-90 lbs/d  >90 lbs/d

- Modeling diets using Cornell Net Carbohydrate and Protein System (CNCPS) for each milk level.
Precision Animal Feeding Program – Project 1

- **Procedures:**
  - Using data to design and implement P reducing feeding strategies
    - seeking to implement P reductions by manipulating the purchased feeds in the diet (not forages)
  - Analyzing manure for P content before and after implementation
Precision Animal Feeding Program - Project 1

Results –
Dietary Monitoring and Modeling
## Dietary P Intakes - Actual Results

Phosphorus Intake, % of Requirement

<table>
<thead>
<tr>
<th></th>
<th>&lt;50</th>
<th>50-70</th>
<th>70-90</th>
<th>&gt;90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd A</td>
<td>154%</td>
<td>171%</td>
<td>174%</td>
<td>161%</td>
</tr>
<tr>
<td>Herd B</td>
<td>145%</td>
<td>149%</td>
<td>140%</td>
<td>130%</td>
</tr>
<tr>
<td>Herd C</td>
<td>116%</td>
<td>108%</td>
<td>106%</td>
<td>99%</td>
</tr>
<tr>
<td>Herd D</td>
<td>133%</td>
<td>115%</td>
<td>107%</td>
<td>101%</td>
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</table>
### Forage P levels

<table>
<thead>
<tr>
<th>DairyOne lab (NYS)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legume hay</td>
<td>.26 ±.06</td>
</tr>
<tr>
<td>Legume silage</td>
<td>.32 ±.06</td>
</tr>
<tr>
<td>Grass hay</td>
<td>.24 ±.08</td>
</tr>
<tr>
<td>Grass silage</td>
<td>.31±.07</td>
</tr>
<tr>
<td>Corn silage</td>
<td>.23±.03</td>
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</tbody>
</table>

**Project 1 Forages 1999-2000**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
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<tbody>
<tr>
<td>Legume and MML Hay and Silage</td>
<td>.39±.05</td>
</tr>
<tr>
<td>Grass and MMG Hay and Silage</td>
<td>.41±.09</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>.27±.05</td>
</tr>
</tbody>
</table>
Precision Animal Feeding Program - Project 1

Results – Dietary Intervention
Results – Dietary Intervention

- Reduced P feed imports and predicted manure P excretions:
  - 14.5 kg per cow per year in Herd A
    • 40 g/cow/day
  - 9.1 kg per cow per year in Herd B
    • 25 g/cow/day

30%+ reduction in feed P imports
30-36% predicted reduction in manure P excretions
Results – Dietary Intervention

- Reduced Manure P Content:

  Average for Herds A&B

  Before  - 1.32 % of fecal DM
  After   - 0.88 % of fecal DM

  33% reduction (agrees with CNCPS model)
Dietary P Reductions
- Implications for Cannonsville

- 7000-8000 mature cows in Cannonsville basin
- Assume 9 kg per cow/yr reduction across all mature cows is achieved
Dietary P Reductions
- Implications for Cannonsville

Results in:
64,000 – 73,000 kg
less P imported per year into the basin and excreted in dairy manure produced in basin

50,000 kg avg. annual P load into Cannonsville reservoir
Implementation Strategies

- **Herd A**
  - High P content forages
  - Had no mineral P in grain to begin with!
  - High P byproducts in grain pellets
    - Wheat midds primarily
Implementation Strategies

- Herd A
  - Moved to full 2 feed system
    - High protein “meal” concentrate and corn meal
    - Still feeding wheat midds but much lower level.
  - Had to use this system to reduce wheat midds, while not increasing feed costs.
Herd A
- Farmer able to feed it
- Cows ate it
- Feed costs reduced approx. $0.20 per cow/d
  - Approx. $5,000 per year for this herd
  - Due to 2 feed system
Implementation Strategies

- Herd B
  - High forage P content
  - Meal feed with mineral P added
  - Some high P byproducts
    - Distillers, soybean oil meal
Implementation Strategies

- Herd B
  - Removed mineral P from feed only
  - Small reduction in feed costs
    - $0.02 per cow/day
    - Approx. $400/year for this herd
    - Due to pricing structure on mineral sources
Precision Feed Management:

Comprehensive Forage Management
Forage Management

- Forage Management Components
  - Forage species selection (quality, fertility, erosion)
  - Forage establishment (erosion)
  - Precision plant feeding (fertility, Precision Ag)
  - Forage harvest timing (quality)
  - Forage yield (P removal rate, feeding impacts)

List is not complete!!
Forage Species Selection: BMR Sorghum Sudangrass

- High forage quality (potential for reduction of purchased feed nutrients)
- Less soil erosion than corn
- Allows summer manure spreading (better from hydrologic sensitivity standpoint)
- Cover crop for winter
- Low P content (helps for reduced P diets)
Forage Establishment and Fertility

- No till/Min. till forage establishment (?)
- Cover Crops, interseedings (Del Co. demos)
- Reduced or no P starter fertilizer
  - Q. Ketterings, Cyzmmek statewide corn P starter plots and P solubility trials
- Precision Agriculture – fertilizer and spray applications
Forage Quality Impacts: Intensive Pasture

- Intensively managed pasture
  - Reduced grain feeding by up to 25%
    - Equals approx. 0.8 lbs less P intake and manure excretion per cow per month
  - Lower CP grain for late lactation cows
    - May be able to reduce P intake and excretion on these cows by 10%
# Forage Yield: Intensive Grass Management

<table>
<thead>
<tr>
<th>Nitrogen Rate, Lbs/ac</th>
<th>P Removal, Lbs P&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;5&lt;/sub&gt;</th>
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<tbody>
<tr>
<td>Hamden, 1999</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>55</td>
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<tr>
<td>125</td>
<td>82</td>
</tr>
<tr>
<td>250</td>
<td>101</td>
</tr>
<tr>
<td>375</td>
<td>89</td>
</tr>
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Forage Management

- Many facets to consider
- Impacts on water quality complex
- Much potential
- Needed for dairy industry in Northeast
Comprehensive Nutrient Management Planning: Expanding the Horizons
CNMP Components

- Precision Feeding
- Forage Management
- Soil and Water aspects of the farm
- Manure Management
- Economic Assessment