Precision Feed Management and its Role in Watershed Protection

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Agriculture and Non Point Source Pollution:

1998 US EPA Report to Congress

US Rivers and Streams

US Lakes, Reservoirs and Ponds

Nutrients

Cornell Cooperative Extension Delaware County
Cannonsville Reservoir NPS Phosphorus Load

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

Bishop, 2001
Regulation of Non Point Source Loads:

Total Maximum Daily Loads (TMDL)
Regulation of Non Point Source Pollutant Loads:

Meeting the TMDL Challenge:

- Requires “load allocations” for point and non point sources
  - How much pollutant can come from each point and non point source
  - Quantification and documentation!!!
Regulation of Non Point Source Pollutant Loads:

Meeting the TMDL Challenge:

- Communities responsible for meeting the TMDL
  - Regulatory [= economic] consequences
  - Held to a standard of performance in meeting the TMDL

“Performance Based” Approach
  vs
“Plan Based” Approach
Regulation of Non Point Source Pollutant Loads:

Meeting the TMDL Challenge at the farm:

- How can we take a performance based approach all the way back to the farm?
- What are the performance measures at the farm going to be?
- What are the performance standards at the farm going to be?
Base Case Future Predictions:
Repeating 1988-1999 Climates for 72 years
(to eliminate Climate trends)

P load to reservoir simulated to increase over time!
11.4% increase in P load to reservoir over 60 yrs

Tolson and Shoemaker, 2003
Why is P Increasing?

MASS BALANCE:

INPUTS to basin

= 171,300 to 333,300 kg/yr

OUTPUTS from basin in kg/yr = 65,000 kg/yr

Thus, there is a NET P ACCUMULATION = 106,300 to 268,300 kg/yr in basin (soils)

OR

~ 5 kg P/ha agr. land/yr based on 106,300 kg/yr

Tolson and Shoemaker, 2003
The Dairy Industry and the Mass Nutrient Balance Dilemma:
The Dairy Farm
Mass Nutrient Balance

Imported Nutrients

Feed
Fertilizer
Bedding
Animals

Nutrients remaining on farm

Run off
Leaching

Exported Nutrients

Milk
Crops
Animals
Manure

Nutrient Losses to water
Regional Translocation of Phosphorus

Grain P
Manure P
P rock

A. Sharpley, USDA ARS
Imports

Distribution of Imports (%)
Exports

Distribution of Exports (%)

Workshop participants

- Crops
- Animals
- Milk
P Accumulation vs Milk/ac

P₂O₅ lbs/ac/yr vs Milk/ac

Workshop participants

Cooperative Extension
Delaware County
The Mass Nutrient Imbalance:
Root of the Nutrient TMDL challenge

Cannonsville Reservoir:
• 50,000 kg total annual P load

Cannonsville Basin:
• 125,000 – 325,000 kg/yr feed P imported per year, est.
• 80,000 kg/yr soil P accumulation
  (Tolson and Shoemaker, 2003)
Addressing the Mass Nutrient Imbalance Through Feed Management
Feed Management Recognized

Council for Agricultural Science and Technology (CAST) – Issue Paper 21, 2002

- Animal diet modification to decrease the potential for nitrogen and phosphorus pollution

USDA-NRCS 590 (592) Nutrient Management Planning Standard

- Identifies Feed Management as part of a comprehensive nutrient management plan
Nutrients and the Dairy Industry: Feed Phosphorus in the Cannonsville Reservoir:

- 50,000 kg total annual P load

Cannonsville Basin:

- 7000 – 8000 mature cows
- 125,000 – 325,000 kg/yr imported feed P est.
- 80,000 kg/yr agricultural soil P accumulation, est.

(Tolson and Shoemaker, 2003)
Feed Management Impacts: Beyond the Farm

Cannonsville Reservoir:

- 50,000 kg total annual P load

- Achieve a 20% feed P reduction on all mature cows in basin:
  
  $= 64,000 - 73,000 \text{ kg/yr}$

- Reduction in Feed P imports into basin and Manure P excretions in basin

- 33% reduction in manure P content

- 50% reduction in amount of P remaining on farm
So it appears it can be done and with great promise.....

But How?
Requirements of a Successful Feed Nutrient Management Program

Program Must:
- Adapt to the dynamic nature of feeding cows
- Address the foundation of feed nutrient recycling on the farm (homegrown feeds)
- Affect long term change
- Not negatively impact farm economic viability
Requirements of a Successful Feed Nutrient Management Program

Program Must:

- Be repeatable from farm to farm
- Be structured to work with farm over time to implement incremental change
- Work within the current support infrastructure of the farm
- Have a standard of identity
- Have “institutional” standing as a BMP for nutrient management
Simple enough.
So what has held us back?
The Horror of what might be?
Relax.
Reality Check:
Feed Nutrient Management

The government cannot take over balancing dairy rations.

Extension and NRCS/SWCD professionals are often well suited to understand and advise in crop and feed management from a production and environmental perspective.
Relax.
Reality Check:
Feed Nutrient Management

Someone needs to develop & facilitate a feed nutrient management program

Someone needs to count the beans (changes in nutrient loading) at the end of the day

Someone needs to connect this effort w/in a local community (County, SWCD, etc)
Relax.
Reality Check:
Feed Nutrient Management

- Who has the talent?
- Who has the interest?
- Who has the time?
- Who has the mandate?
Feed Management for Environmental Management: How?

Precision Feed Management
Precision Feed Management:

What is it?

- A Process implemented on a farm in a sequential manner.
  And/Or

- A Program implemented across farms in a watershed for a collective benefit.
Feed Management for Environmental Management: The farm process

Precision Feed Management

Precision Feeding ↔ Forage Systems Management
Precision Feeding

“Site Specific Diet formulation and delivery”

- More precisely describe dairy cow nutrient requirements (farm specific)
- More accurately describe feed nutrient content.
- More tightly balance dairy cattle diets for animal requirements.
- Delivery of targeted diets
Feed Management for Environmental Management: The Process

Precision Feed Management

Precision Feeding ↔ Forage Systems Management
Forage Systems Management

A defined, repeatable, continuous improvement process to:

- Improve homegrown forage production (quality and quantity)
- Increase utilization of homegrown feeds to reduce mass nutrient imbalances.
- Reduce field edge nutrient losses through forage management.
Precision Feed Management: The Program

- Farm Precision Feed Planning
- Integration
- Research & Development
- Education
The Precision Feed Management Program

Coop Ext. planners, farmer, & advisors:
- Farm forage and precision feeding plan
- Document Impacts

Farm Precision Feed Planning

Integration

Cornell/Coop Ext/USDA ARS:
- Field research
- Model Application/Development (CNCPS 6.0 etc.)

Research & Development

Coop. Ext/Cornell:
- Farmer education
- Feed Industry training (CNCPS)

Education

Cooperative Extension
Delaware County
Precision Feed Management: The Program

- Precision Feed Team works with farmer and feed reps, others to develop PFM plan
  - Semi annual forage planning and evaluation mtngs
  - Monthly herd ration data collection
  - Develop feeding plan w/farmers/feed reps
Precision Feed Management: The Program

- Precision Feed Team works with farmer and feed reps, others
  - On farm consultation in implementing strategies
  - Data sharing with Feed reps
  - Team collects and summarizes ration/cow/farm impact data
Backstopping implementation on farms with local Research and demonstration

- Forage Systems Management
- Feeding strategies
- Dairy cow model (CNCPS)
- Watershed scale water quality modeling
- Economic impact study (farm level)
Precision Feed Management: The Program

Facilitating long term change through farm and feed company education

- Individualized feed company CNCPS training
- Feed and vet roundtable meetings
- Forage crop management meetings
- Dairy nutrition and health meetings
- Precision Forage and Feeding Systems Curricula
- Newsletter articles
Precision Feed Management Program

Objectives:

– Develop systematic and repeatable Precision Feed Management process
  – Pilot and document

– Test nutrient accumulation as an on farm performance measure

– Determine the lower limits of nutrient accumulation on our dairies through improved forage management and high forage diets
Precision Feed Management Program

Objectives:

– Determine the economic impact of precision feed management on the farm
– Develop process to implement precision feed management in collaboration with feed industry.
– Create and educational wave that improves feed management on farms.
DCAP Precision Feed Management Timeline

- Pilot precision feeding study 1999-2002
- CNCPS development and training (2001+)
- Phase 2 precision feeding project (2003-2006 Cannonsville Basin)
- Pilot forage systems project (2003-2006 Cannonsville)
- Processes developed and documented
- Implement Precision Feed Management large scale and in other basins (200?+)
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