**Northern New York Agricultural Development Program
2019 Project Report**

Northern New York Dairy Representation in Regional Assessment of a New Phosphorus Index Approach (phase 2)

Project Leader:
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Collaborators:
- Five NNY dairy farms
- Miner Institute: Laura Klaiber
- Nutrient Management Planners: Eric Beaver, Mike Contessa of Champlain Valley Ag and other consulting firms
- Cornell campus: Mart Ros and Karl Czymmek
- Cornell Cooperative Extension

Background:
The New York Phosphorus Index (NY-PI) is used to score fields based on their risk of phosphorus (P) loss so that high-risk areas can be identified. The original NY-PI was released in 2001. Since then, fertilizer use declined considerably, Morgan soil test P (STP) statewide has leveled off, and P management on dairy farms has become more efficient, as shown in longer-term whole-farm P balance records. Nevertheless, ongoing environmental challenges, such as surges of algal blooms in major U.S. water bodies and in lakes in NY, as well as an improved understanding of P movement and management options, warrant recent efforts to improve the effectiveness and accuracy of the NY-PI.

In 2017, we introduced a new approach, based on feedback from planners and consultants, and building on the evolving body of science on P dynamics and risk of P runoff. In the new approach, farm fields are first scored based on their inherent risk of P transport (derived from individual landscape-based factors such as soil erodibility, soil drainage, field distance to a stream, etc.). This NY-PI 2.0 approach promotes use of best/beneficial management practices (BMPs) for manure application through use of a BMP crediting system (i.e., raw transport-based PI scores can be reduced if BMPs are implemented). This is called the *transport × BMP approach* (in contrast to the source × transport approach of the orginal NY-PI). Soil test P serves as a classification tool (Table

1 | Page

1), which may also be used to quickly identify high-risk areas (fields with STP > 160 lbs/acre).

Table 1. Manure management implications in the NY-PI 2.0, based on a transport × BMP score, and Morgan soil test P values.

Inherent P loss risk	NY-PI score	Morgan soil test P (lbs/acre)			
		< 40	40-100	101-160	≥ 160
Low	< 50	N-based	N-based	P-based	Zero
Medium	50 to 74	N-based	P-based	Zero	Zero
High	75 to 99	P-based	P-based	Zero	Zero
Very high	≥ 100	Zero	Zero	Zero	Zero

The NY-PI 2.0 aims to incentivize evaluation of field STP levels to ensure these levels stay in the optimum range. For fields with STP < 160 lbs/acre, the NY-PI 2.0 first assesses risk of runoff (potential for P transport from the field) based on field attributes. The result of the assessment is a "raw score" (prior to BMP selection). The raw score can then be reduced by implementation of BMPs selected from options related to (1) P application method, and (2) ground coverage/timing (see Table 2).

In addition to being more intuitive than the original NY-PI and incentivizing BMP implementation on higher risk fields, the transport × BMP approach of the NY-PI 2.0 has the advantage of also being easily adapted to the development of new nutrient management practices. This approach also allows for easier use and comparison across state boundaries.

Methods:
The process of updating the NY-PI was a broad partnership among faculty and staff in the Nutrient Management Spear Program (NMSP), PRO-DAIRY, and the Department of Biological and Environmental Engineering at Cornell University, along with the New York State Departments of Agriculture (NYSDAM) and Environmental Conservation (NYSDEC), and the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS). Feedback from certified nutrient management planners and farmers was encouraged in multiple instances along the way. In recent years with NNYADP grant funding, we worked with five NNY dairy farms (eighteen NY dairies in total) to evaluate the impact of the NY-PI 2.0 on the potential for manure allocation for fields, and need for implementation of manure application BMPs. Each of the farms shared their NY-PI records and conducted a whole-farm nutrient mass balance (NMB). For each of the farms, impact of implementation of various BMP combinations on manure application rate limits was assessed. Once the assessments were done, the research team visited the planner and farm manager(s) to share results and discuss the outcomes. These meetings resulted in some adjustments in NY-PI 2.0 factors. For example, hydrologic soil group was substituted as a single proxy for the combined effects of soil drainage class and subsurface (artificial) drainage.

Results:

Evaluation and Feedback:

Evalation of farm data across more than 33,000 fields (statewide) showed that 90% of the fields had a STP below 40 lbs/acre, where additional P is recommended for optimal crop growth. A small fraction of fields in the database (~0.5%) had extremely high STP levels (reflecting past management). The separate assessment of 18 dairy farms showed similar trends. Almost all fields on these farms, including those in northern NY were able to receive manure, although a portion of the fields needed manure and fertilizer BMPs.

NY-PI 2.0

The NY-PI 2.0 (Table 2) was presented at the 2019 Northeast Region Certified Crop Advisor annual meeting in Syracuse, NY. A link to whole farm P use efficiency was made by adding an adaptive management option to the NY-PI 2.0; farms with a whole-farm P mass balance (3-yr running average) at or below 12 lbs P/acre can apply manure at N-based rates on fields with STP≤100 lbs P/acre, even if the initial NY-PI 2.0 score limits rates to P-based, as long as the selected BMPs to get to a P-based score are implemented.

Table 2: The New York Phosphorus Index (NY-PI) 2.0.

Overall interpretation (transport factor score × BMP score × 10)				
Management implication[1]				
P-loss risk	PI score	Soil test P (Cornell Morgan extraction in lbs/acre)		
		< 40	40-100	101-160	> 160
Low	< 50	N-based	N-based	P-based	Zero P
Medium	50-74	N-based	P-based	Zero P	Zero P
High	75-99	P-based	P-based	Zero P	Zero P
Very high	≥ 100	Zero P	Zero P	Zero P	Zero P

Transport factors
(DP score = FD + FF + CF + HSG$_{DP}$ + VB$_{DP}$; PP score = FD + FF + CF + HSG$_{PP}$ + E + VB$_{PP}$)

Factor	Option	Coefficient	Factor	Option	Coefficient	
Flow distance (FD) to first intermittent or perennial stream in ft	> 500	0	Hydrologic soil group (HSG)	A	DP: 0	PP: 0
	300-500	4		B	DP: 4	PP: 1
	100-300	6		C	DP: 6	PP: 3
	≤ 100	8		D	DP: 8	PP: 5
Flooding frequency (FF)	Never	0	Erosion (E)[2] in ton/acre	≤ 1	0	
	Occasionally	2		1-3	1	
	Frequent	5		3-5	3	
Untreated concentrated flow (CF)	Absent	0		> 5	5	
	Present	4	Vegetated buffer (VB)	Absent	PP: 0	PP: 0
				Present	DP: -2	PP: -4

Best/Beneficial management practices (BMP score = method × ground cover and timing score)	
Method of applications	Coefficient
Surface spread without setback	1.0
Surface spread with 100-ft setback from down-gradient surface waters[3]	0.8
Surface spread with 35-ft managed vegetative (sod/harvested) setback from down-gradient surface waters[3]	0.7
Incorporation (within 24 h + with 15-ft setback from down-gradient surface waters)	0.7
Injection (with 15-ft setback from down-gradient surface waters)	0.5
Ground cover and timing	

Bare ground and more than 2 weeks before planting	1.0
Bare ground and within 2 weeks of planting (in spring)	0.8
Winter-hardy cover crop (fall/winter)	0.8
Whole-plant corn residue (fall/winter)	0.7
Sod after last cutting (fall/winter)	0.6
Growing sod or row crop/planting green	0.5

[1] Implications: 'N-based' can receive manure based on the crop's N needs; 'P-based' restricts manure and fertilizer applications to annual crop P removal equivalence; 'Zero P' means no P from any source. When Cornell crop guidelines call for P above the STP or rate limits in this table, P can be added to not exceed land grant guidelines as long as the NY-PI 2.0 score is 99 or lower. [2] Determined by the RUSLE2 A-factor. [3] Only for fields with FD ≤ 500 ft.

Conclusions/Outcomes/Impacts:

Based on the evaluations of the five Northern New York and 13 other NY dairies that participated in the study over the past three years, as well as the 33,000 field dataset evaluated in the earlier stages of the project , the NY-PI 2.0 was released for use in December of 2019.

Outreach:

Two extension presentations were given at the Northeast Region Certified Crop Advisor annual meeting in Syracuse, NY, (December 3, 2019), attended by most of the crop consulting and nutrient management planning firms, including those in NNY. We published four articles and shared findings with extension educators as well (see below).

Next Steps:

Our next steps are to:
  (1) run the NY-PI 2.0 on five NNY farms for the 2020 growing season and evaluate its impact on farm manure management decisions;
  (2) evaluate if any changes in coefficients are needed across the soil types and management scenarios of relevance to NNY farmers before the NY-PI 2.0 is incorporated for use under the New York State CAFO Permit; and
  (3) develop training/extension materials that allow for training of planners, extension and district offices in the use of the NY-PI 2.0.

Acknowledgments:

Reports/articles in which results of this project have been published.

Articles:
- Czymmek, K.J. and Q.M. Ketterings (2019). A new Phosphorus Index for NY: Part 1. What farmers need to know. ELeader PRODAIRY, December issue.
- Czymmek, K.J., Q.M. Ketterings, M. Ros, S. Cela, S. Crittenden, D. Gates, T. Walter, S. Latessa, and G. Albrecht (2019). New York Phosphorus Index 2.0.
- Ros, M., K.J. Czymmek and Q.M. Ketterings (2019). Want to be better than average? Use dairy farm nutrient mass balances to improve performance. Progressive Dairymen. The Manager. pp 3-4. March 2019..

- Ros, M., K.J. Czymmek and Q.M. Ketterings (2019). [Better than average: Feasible balances for dairy farms that produce most forage needs.](#) Progressive Dairymen. The Manager. pp 5-7. March 2019.

Talks:
- Czymmek, K.J., M. Ros, and Q.M. Ketterings (2019). The new NY Phosphorus Index. Northeast Region Certified Crop Advisor annual meeting. December 3, 2019. 2 x 50 min. ~100 people total.
- Ketterings, Q.M. and K.J. Czymmek (2019). Nutrient Management Update. 2019 Ag Inservice, November 7, 2019. Ithaca, NY. 2 hrs, ~25 people.

<u>For More Information:</u>
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