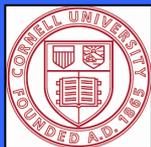


Nutrient Management Planning

Basic NRCCA Training Competency Area 6

Karl Czymmek, PRO-DAIRY
Cornell University

November 29, 2017



Nutrient Management Spear Program
<http://nmsp.cals.cornell.edu>

Nutrient Management Planning

Six Competency Areas:

1: Basic Concepts of Plant Nutrition

2: Basic Concepts of Soil Fertility

3: Soil Testing and Plant Tissue Analysis

4: Nutrient Sources, Analyses, Application Methods

5: Soil pH and Liming

6: Nutrient Management Planning

Nutrient Management Planning

Session Outline

- NRCS 590 standard
- Risk indicators
 - P index
 - N index
- Bigger picture and tradeoffs
- What to do?

NRCS590

Nutrient Management Standard

- Account for nutrients from all sources
- Plan manure application based on crop nutrient needs
- Apply the New York Phosphorus Runoff Index and Nitrate Leaching Index for each field
- Apply appropriate manure application setbacks
- Follow Land Grant University Guidelines for NM
- New standard released 1-2013 and includes new winter manure and PI guidelines.
- 590 up for review 2018

<http://www.ny.nrcs.usda.gov/technical/index.html>

Accounting for Nutrients

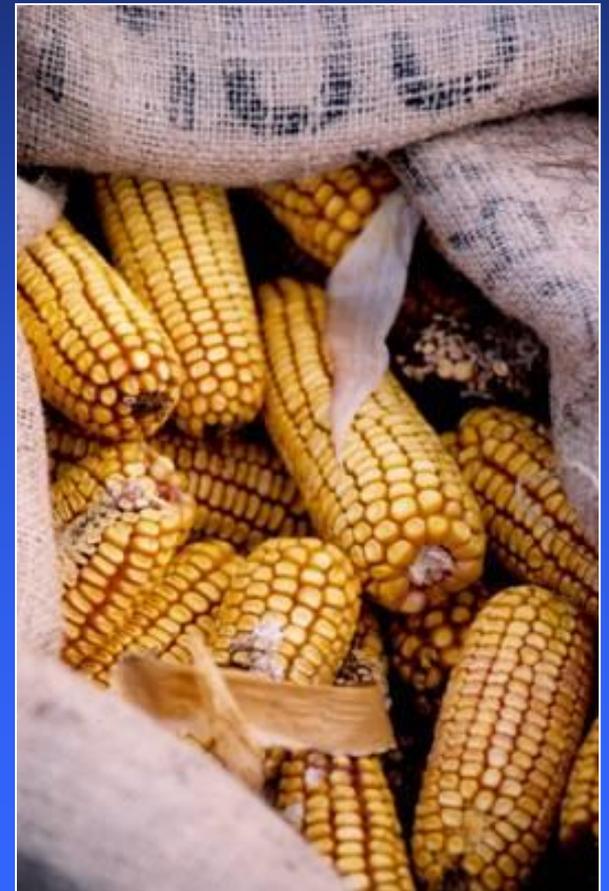
- Soil type
- Soil test (for P, K, Mg, etc.)!!!
 - at least every 3 years
- Records of crop rotations....for sod N credits
- Records of past manure applications....for N credits
- Crop yield potential: book value or 3 years of yield data or end of season evaluation

Use this information to determine a
N-P₂O₅-K₂O recommendation for the field

Corn N Recommendations (NY)

How to find out how much N is needed?

- **Yield potential.**
 - soil type and drainage
- **Soil N supply.**
 - soil type and drainage
- **N fertilizer uptake efficiency.**
 - soil type and drainage
- **N credits from sods.**
 - % legume/grass in the sod
- **N credits from manure.**
 - manure source & application method



Corn N Recommendations (NY)

$$\text{N req.} = \frac{\text{in bushels/acre} \quad \text{in lbs N/acre} \quad \text{in lbs N/acre}}{\text{in lbs N/acre} \quad \text{in \%}} \frac{(\text{yield potential} * 1.2) - \text{soil N} - \text{sod N}}{(\text{fertilizer efficiency}/100)}$$

The equation is annotated with arrows indicating units: 'in bushels/acre' points to 'yield potential * 1.2'; 'in lbs N/acre' points to 'soil N'; 'in lbs N/acre' points to 'sod N'; 'in lbs N/acre' points to the numerator of the fraction; 'in lbs N/acre' points to 'fertilizer efficiency/100'; and 'in %' points to the denominator of the fraction.

For N guidelines for field crops in NY:
<http://nmsp.cals.cornell.edu/guidelines/nutrientguide.html>

Accounting for Nutrients

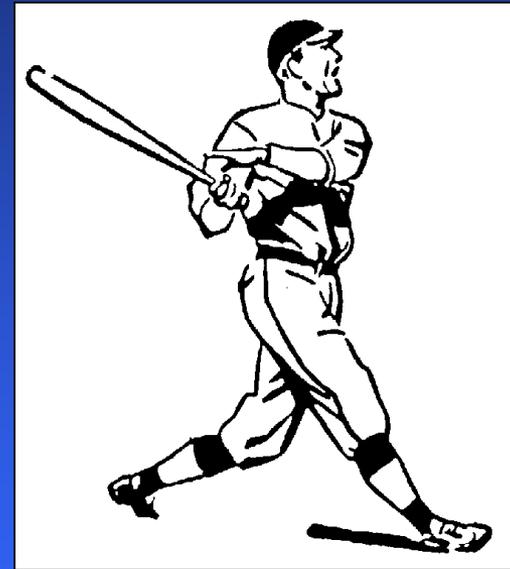
- Know how much manure is produced
- Know manure nutrient content
 - all sources! Manure ponds, bedded packs, etc.
- Know spreading rates
 - for each spreader, range of gears
- What fertilizers and blends are available?

Use this information to plan manure and/or fertilizer applications to satisfy the N-P₂O₅-K₂O recommendation.

Good records (loads spread) beat ballpark estimates any day!

Liquid storage must account for:

1. rainfall
2. runoff
3. milkhouse waste
4. etc.



For manure testing,
see section 3

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P Runoff Index

National NRCS Code 590:

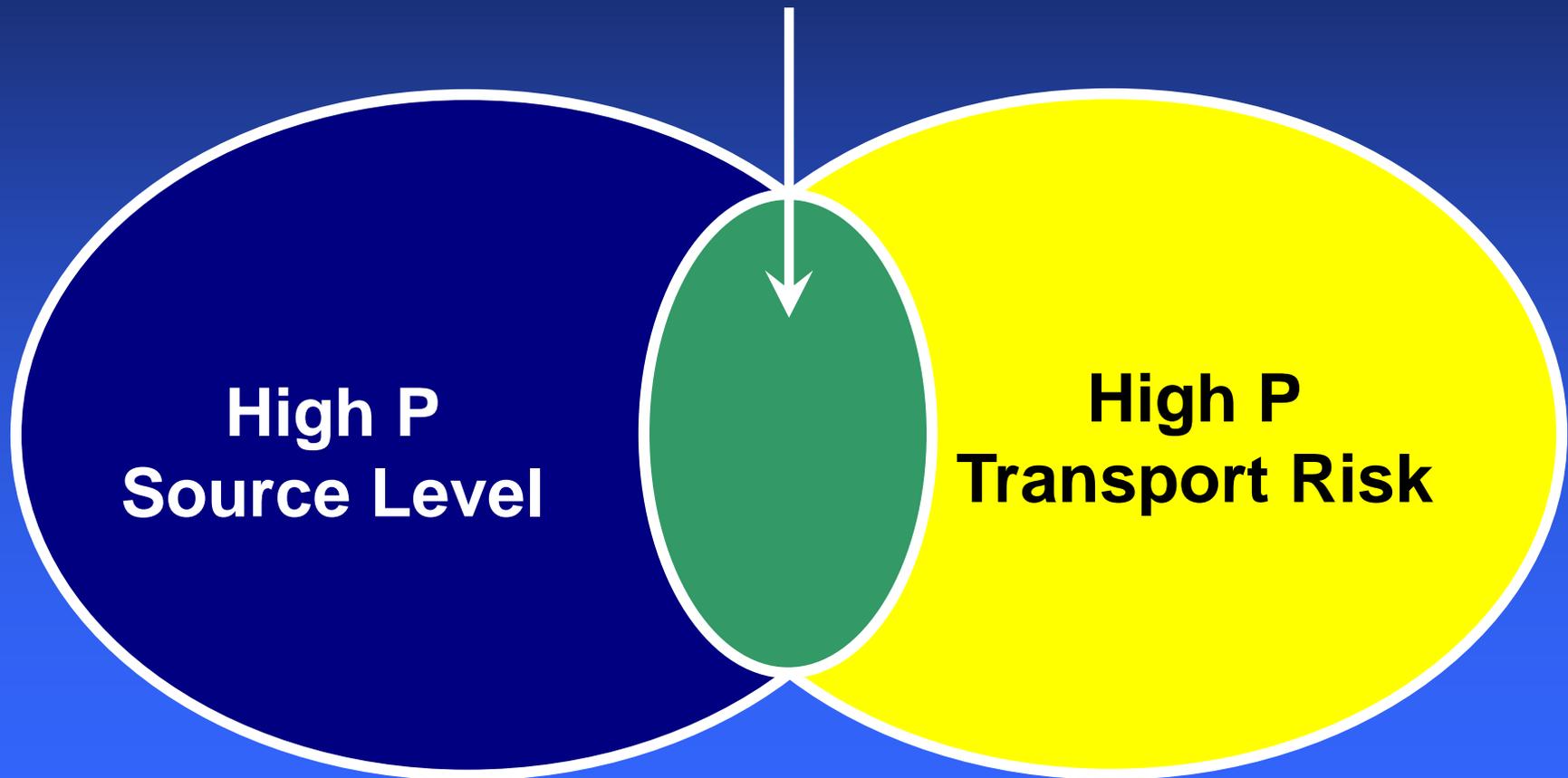
P application using inorganic P and/or manure shall be consistent with either:

- Agronomic soil test
 - if soil test says no P needed, no P is to be added.
- P threshold
 - if soil test P (STP) > threshold, no more P.
- P index - risk determination.

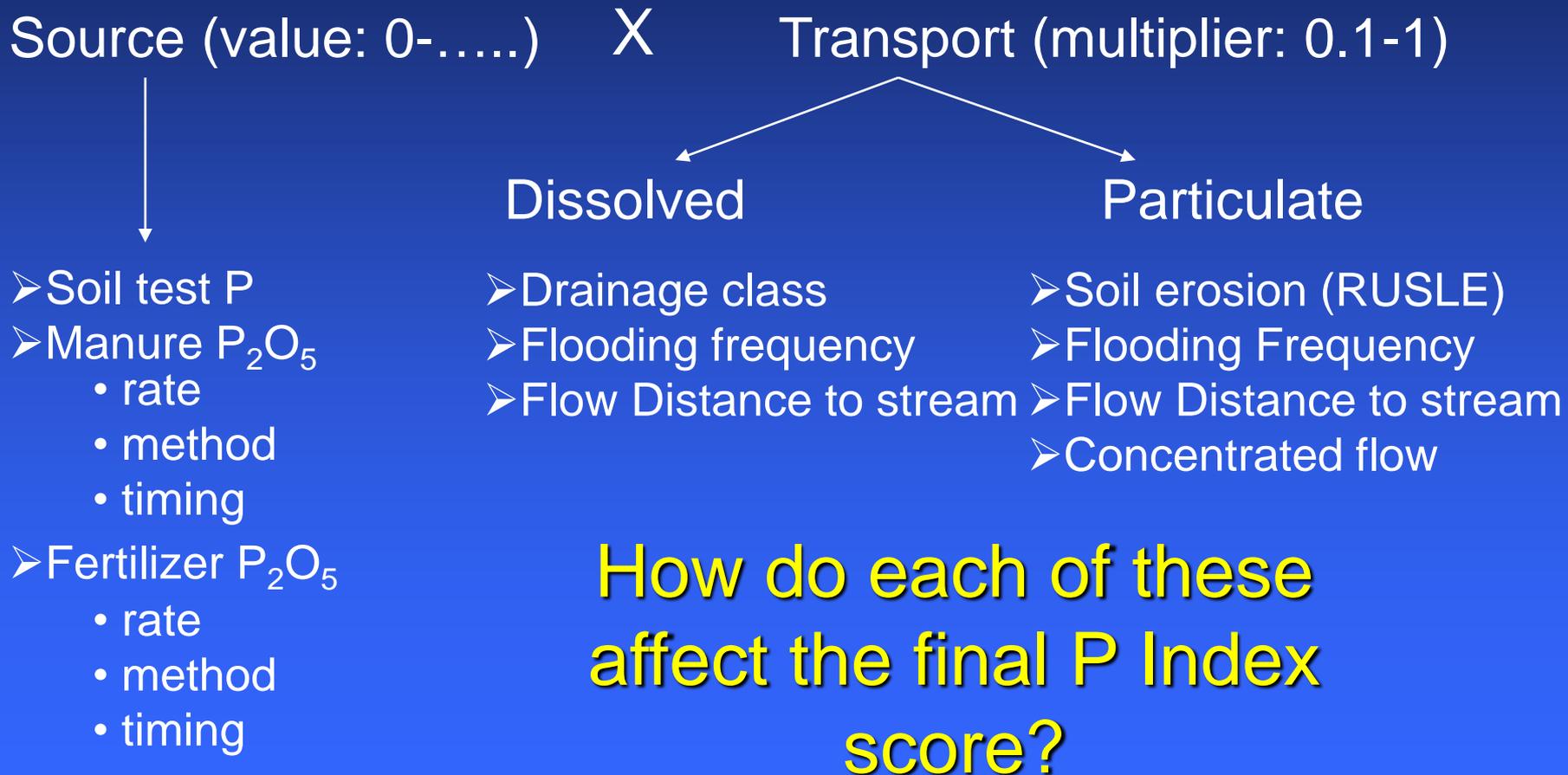
Basic Concept of the P Index

Source/Transport Concept

Critical Source Area



P Index Structure (NY example)



P Index (NY example)

Rankings: Dissolved and particulate PI should each be <100.

P index	Vulnerability	Management recommendation
<50	Low	N based management
50-74	Medium	N based management with BMPs
75-99	High	P applications to crop removal
≥100	Very High	No fertilizer/manure P application

- ✓ Use recommended practices to alter the score.
 - ↘ Incorporate manure, reduce manure/fertilizer rates, buffers, timing of manure applications, create management zones, etc.

N Leaching Index

- NY: Leaching Index

- For more information and NLI computer tools:
<http://nmssp.cals.cornell.edu>



LI based on:

- rainfall (township-level data)
- soil type/hydrologic group (A,B,C or D)

Nitrate Leaching Index (NLI)

Soil Hydrologic Group	Type	Infiltration capacity/ permeability	Leaching potential	Runoff potential
A	deep, well-drained sands and gravels	high	high	low
B	moderately drained, moderately fine to moderately coarse texture	moderate	moderate	moderate
C	impeding layer, or moderately fine to fine texture	low	low	high
D	clay soils, soils with high water table	very low	very low	very high

Nitrate Leaching Index (NLI)

Once the calculations are run....

- According to the NRCS NY590 Standard, if a NLI rating is...
 - < 2: Low potential for leaching below root zone**
 - No additional BMPs, follow Land Grant recommendations
 - 2-10: Intermediate leaching potential**
 - Strongly consider BMPs to limit NO₃ leaching
 - >10: High leaching potential**
 - Expected to implement BMPs to limit NO₃ leaching

Nitrate Leaching Index (NLI)

Some BMPs to limit NO₃ leaching?

- Plant cover crops, esp. with fall manure applications
- Credit N from sods, manure, and soil organic matter
- Apply fertilizer (and manure) N as close (temporally) as possible to a growing crop and according to Cornell Nutrient Guidelines
- Limit fall manure applications to < 50% of crop N need
- Spread manure > 100 ft from wellheads and springs
- Evaluate the need for side-dress N with PSNT
- Don't plow sods in the fall and kill after soil temp declines below 45°F
- See N Leaching Index section in the N documentation for more....

<http://nmsp.cals.cornell.edu/publications/extension/nleachingindex.pdf>

Risk of rainfall/snow melt

- Is this the right day to apply manure?
- High risk includes snow pack and thaw, rainy period in March
- Reduce risk by having enough storage, application setback from streams, avoid bare ground

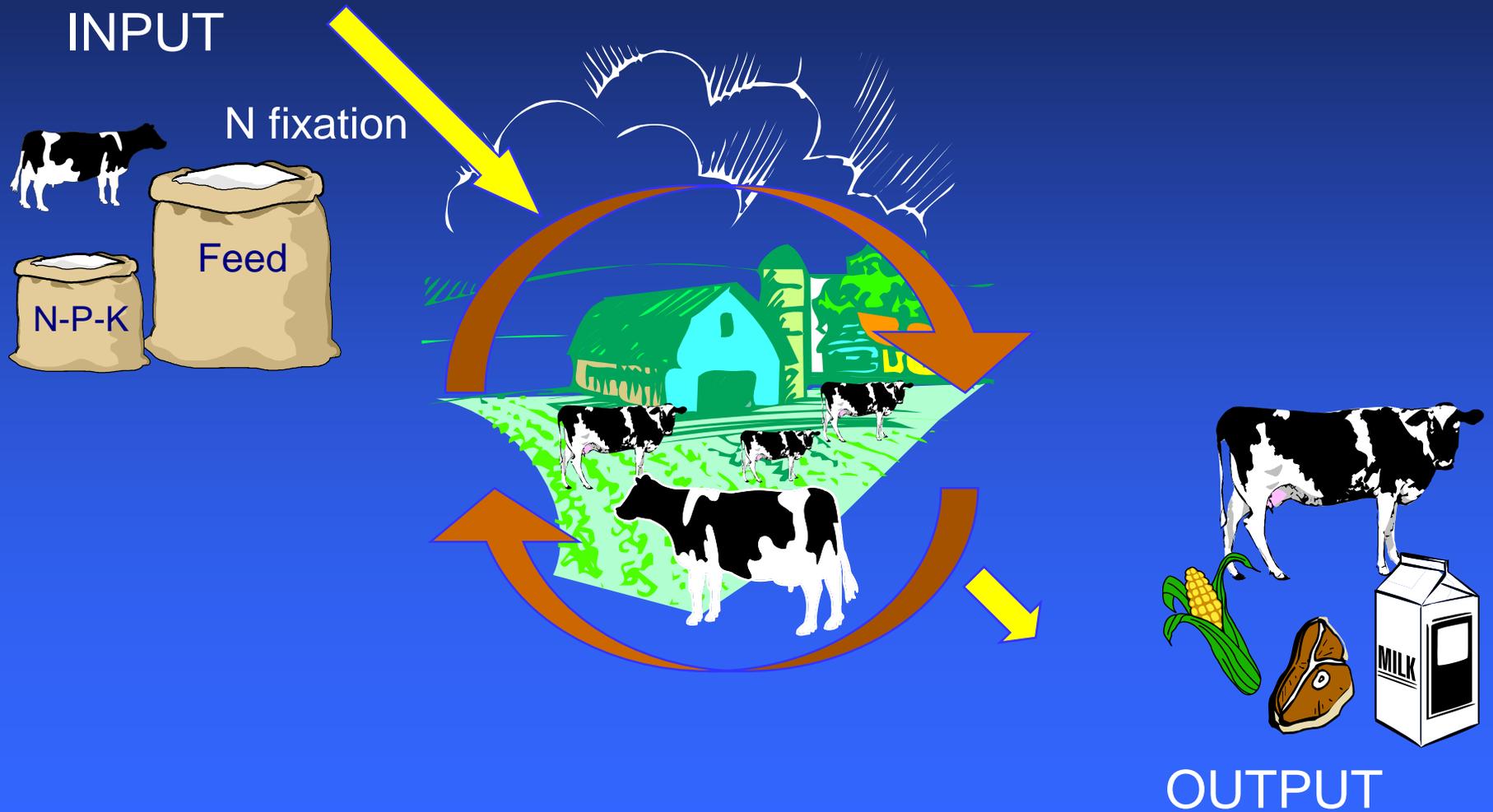


Nutrient Management Planning

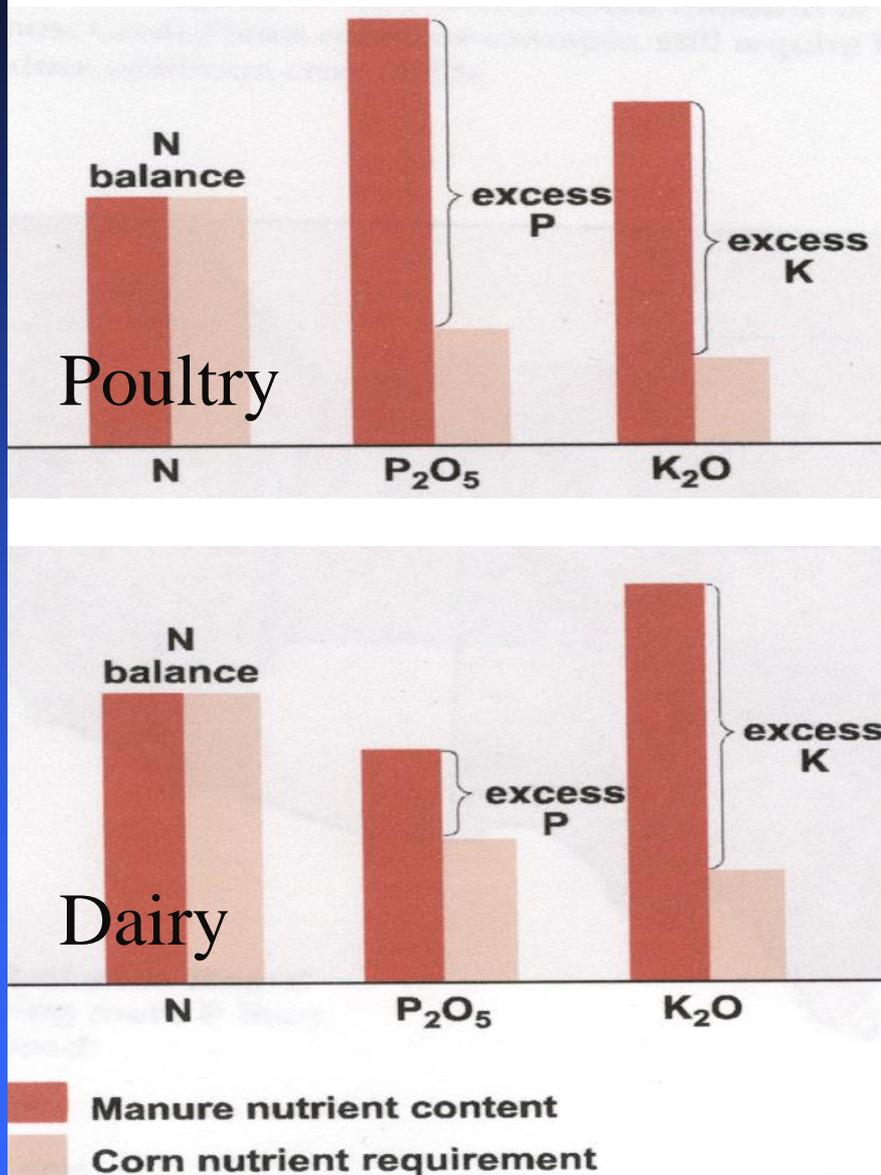
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Nutrient (im)balances



N based manure application:



Example:

Corn guidelines (lbs):

120 N, 40 P₂O₅, 40 K₂O

Layer manure lbs/ton:

37 N, 55 P₂O₅, 31 K₂O

Needed to meet N: ~4 tons

Needed to meet P: <1 ton

Dairy manure lbs/ton:

10 N, 4 P₂O₅, 8 K₂O

Needed to meet N: ~17 tons

Needed to meet P: ~10 tons

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Purchased feed



Milk and meat

Animals



The Farm System

Manure



Soil



Fertilizer

N-Fixation → Crops

Minimize storage losses.



Optimize forage quality and yield to take full advantage of home grown forages.

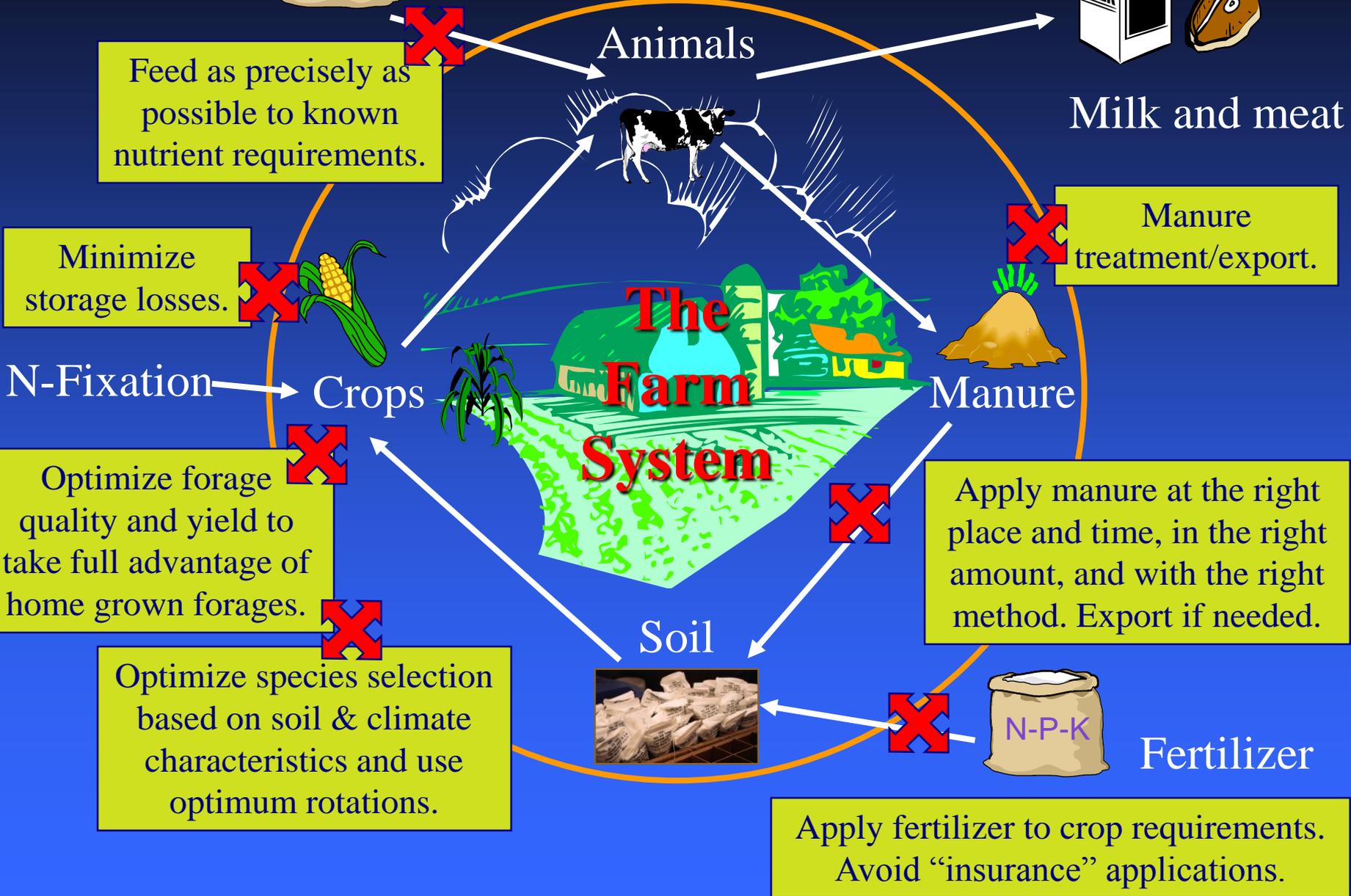
Optimize species selection based on soil & climate characteristics and use optimum rotations.

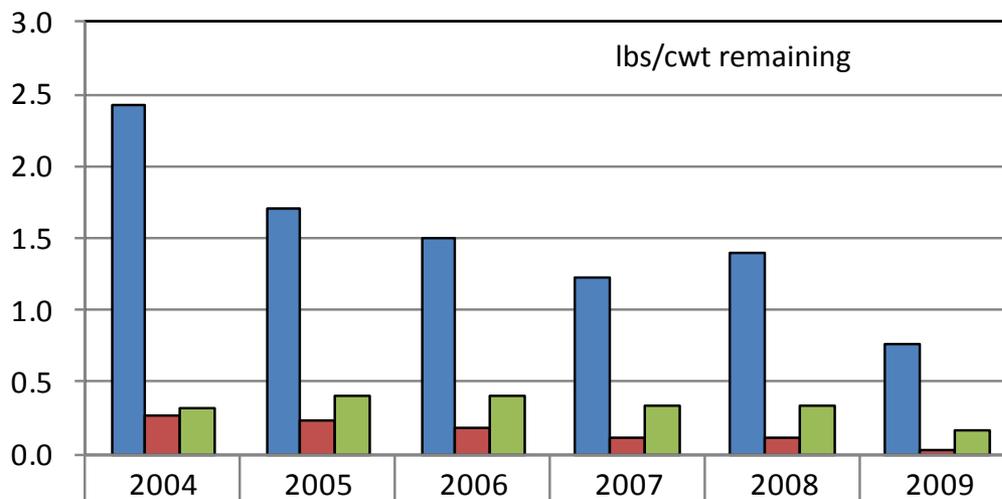
Apply manure at the right place and time, in the right amount, and with the right method. Export if needed.

Apply fertilizer to crop requirements. Avoid "insurance" applications.

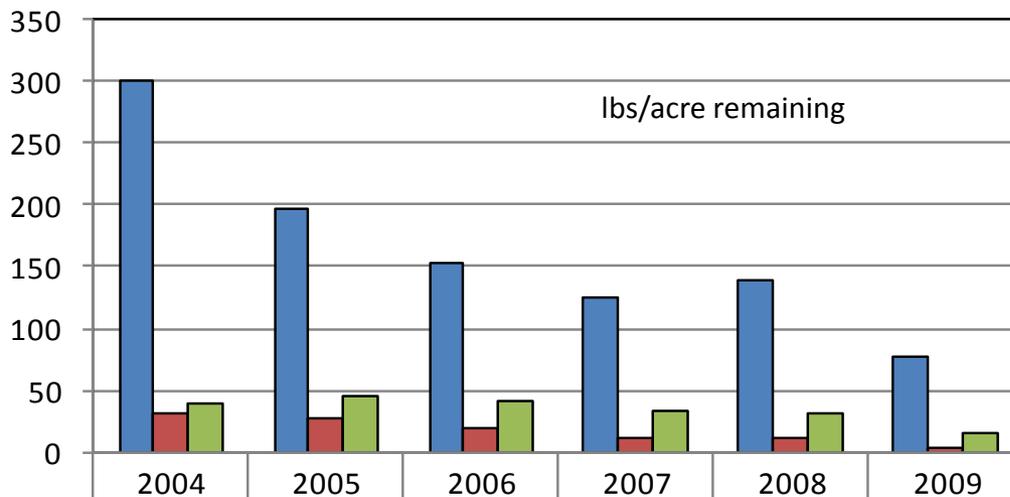
Feed as precisely as possible to known nutrient requirements.

Manure treatment/export.





■ Nitrogen	2.43	1.71	1.5	1.22	1.4	0.77
■ Phosphorus	0.26	0.23	0.19	0.12	0.11	0.03
■ Potassium	0.32	0.4	0.41	0.34	0.33	0.16



■ Nitrogen	301	196	152	125	138	77
■ Phosphorus	32	27	20	12	11	3
■ Potassium	40	46	42	34	32	16

Whole-farm
N, P and K
nutrient
balances
reflect
improvements
over time

Nutrient Management Spear Program



Cornell University
Nutrient Management Spear Program

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The vision of the Cornell University's Nutrient Management Spear Program is to assess current knowledge, identify research and educational needs, conduct applied, field and laboratory-based research, facilitate technology and knowledge transfer, and aid in the on-farm implementation of beneficial strategies for field crop nutrient management, including timely application of organic and inorganic nutrient sources to improve profitability and competitiveness of New York State farms while protecting the environment. For more information about our program activities see our [Program Report](#).

News RSS

- 11/15/2017: Call for Action: Participate in Whole Farm Nutrient Mass Balance Assessments, Input Data Sheets, and Input Data Sheet Instructions, Posted on the MNB Project Page.
- 11/14/2017: Impact Story: NYFVI Project with NMSPE and Industry Evaluates Sensor Technology for Nitrogen Management.
- 8/22/2017: Student Impact Story: Cornell Sustainable Animal Agriculture Internship Gave Nikki Luijben from the Netherlands a Unique Learning Experience.
- 7/28/2017: What's Cropping Up? Series: Phosphorus and the Environment Article 4: Greatly Improved Nutrient Efficiency Demonstrates New York Dairy Farmers' Environmental Stewardship.
- 7/17/2017: What's Cropping Up? Series: Phosphorus and the Environment Article 3: Protecting Our Lakes: Shoreline Septic System Concerns.
- 6/21/2017: What's Cropping Up? Series: Phosphorus and the Environment Article 2: Settling the Record Straight: Comparing Bodily Waste Between Dairy Cows and People.
- 6/21/2017: What's Cropping Up? Series: Phosphorus and the Environment Article 1: An Introduction to Phosphorus.
- 5/25/2017: Cornell CALS Announcement: Northeast Region Phosphorus Index Project, ASA/SSSA/CSSA and ICCA Announcement: A Better Way to Manage Phosphorus.

Featured Links

- [New York On-Farm Research Partnership](#)
- [Cornell Nutrient Guidelines for Field Crops](#)
- [Agronomy Factsheets](#)
- [Impact Statements](#)
- [Nutrient Management Tutorials](#)

Featured Articles

- [Whole Farm Nutrient Mass Balances in Summary; Feasible Whole Farm Nutrient Mass Balances; Change in Nutrient Mass Balances over Time for 54 New York Dairy Farms; Trends in Nutrient Mass Balances on Four New York Dairy Farms.](#)
- [Northeast Region Certified Crop Adviser \(NRCCA\) Manual: Pest Management; Crop Management; Soil & Water Management; Soil Fertility and Nutrient Management.](#)

Upcoming Events

- 2017 NRCCA Annual Training, DoubleTree, Syracuse, NY, November 28-30, 2017.
- 2018 ASA/CSSA International Annual Meeting, Baltimore, MD, November 4-7, 2018.
- 2019 SSSA International Soils Meeting, San Diego, CA, January 6-9, 2019.

Photo Gallery



Jobs and Scholarships

- NMSPE Undergraduate Student Summer Internships. Email: qmk2@cornell.edu to Inquire for Summer Internships and Work During Semesters.

NMSPE Laboratory

- [Submission Form ISNT, CSNT, Cornell S-Test. Address for Samples: NMSPE Laboratory, c/o Quirine Ketterings or Sanjay Gami, 323/317 Morrison Hall, Animal Science, Cornell University, Ithaca NY 14853.](#)
- [CSNT Sampling Instructions \(2016\).](#)
- [NMSPE Laboratory Manual \(2017\).](#)

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