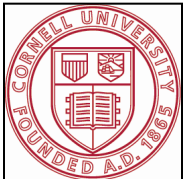
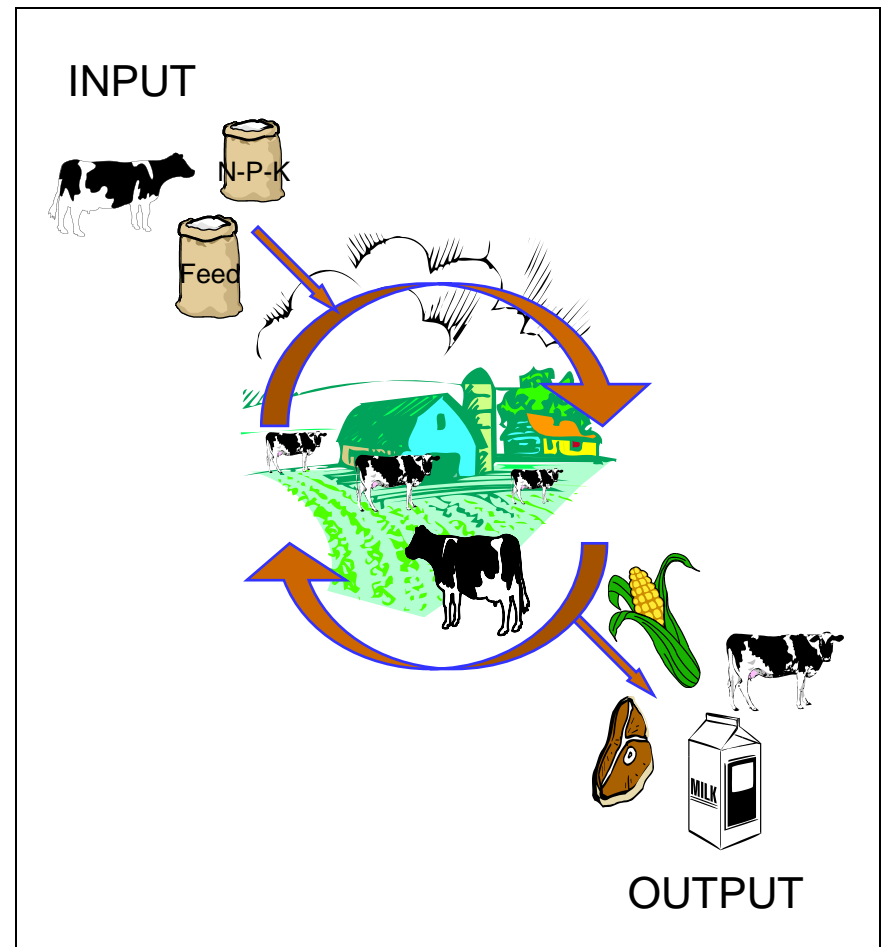


Importance of Using a Systems Approach for Managing Ammonia Losses from Dairies

Quirine Ketterings
Animal Science
Cornell University



Nutrient Management Spear Program, Cornell University

New York State

New York Agriculture

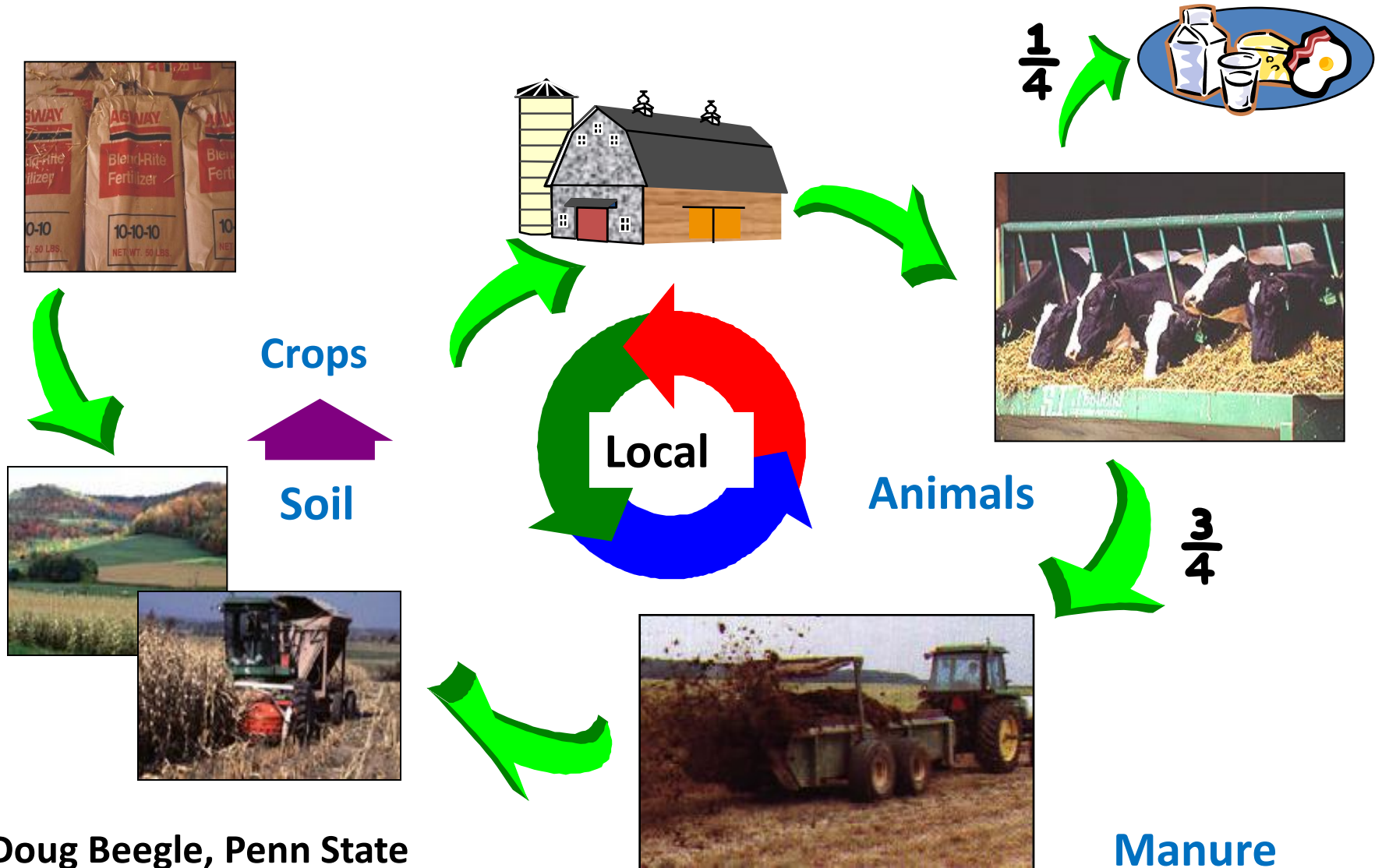
- Agriculture is important to New York State.
- Agricultural production returned almost \$4.4 billion to the farm economy in 2008.

Dairy Products

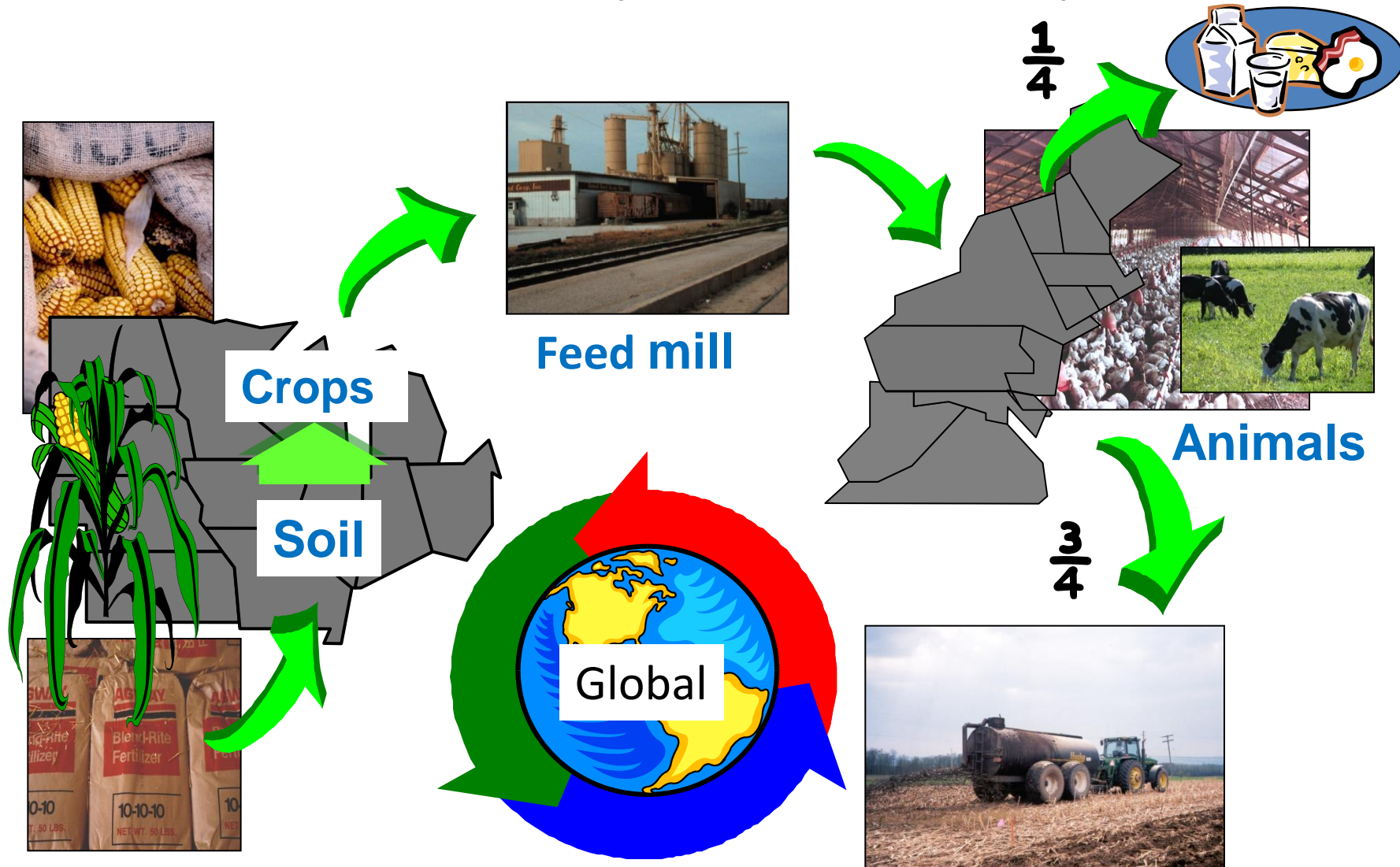
- Milk sales account for one-half of total agricultural receipts. New York is the nations 3rd leading producer. Wyoming County is highest producing.

The sustainability of
dairy and livestock farms
in New York State will depend
greatly on their ability to
protect air and water quality
from the effects of
excess nutrients!

Traditional Nutrient Cycle



Contemporary Nutrient Cycle

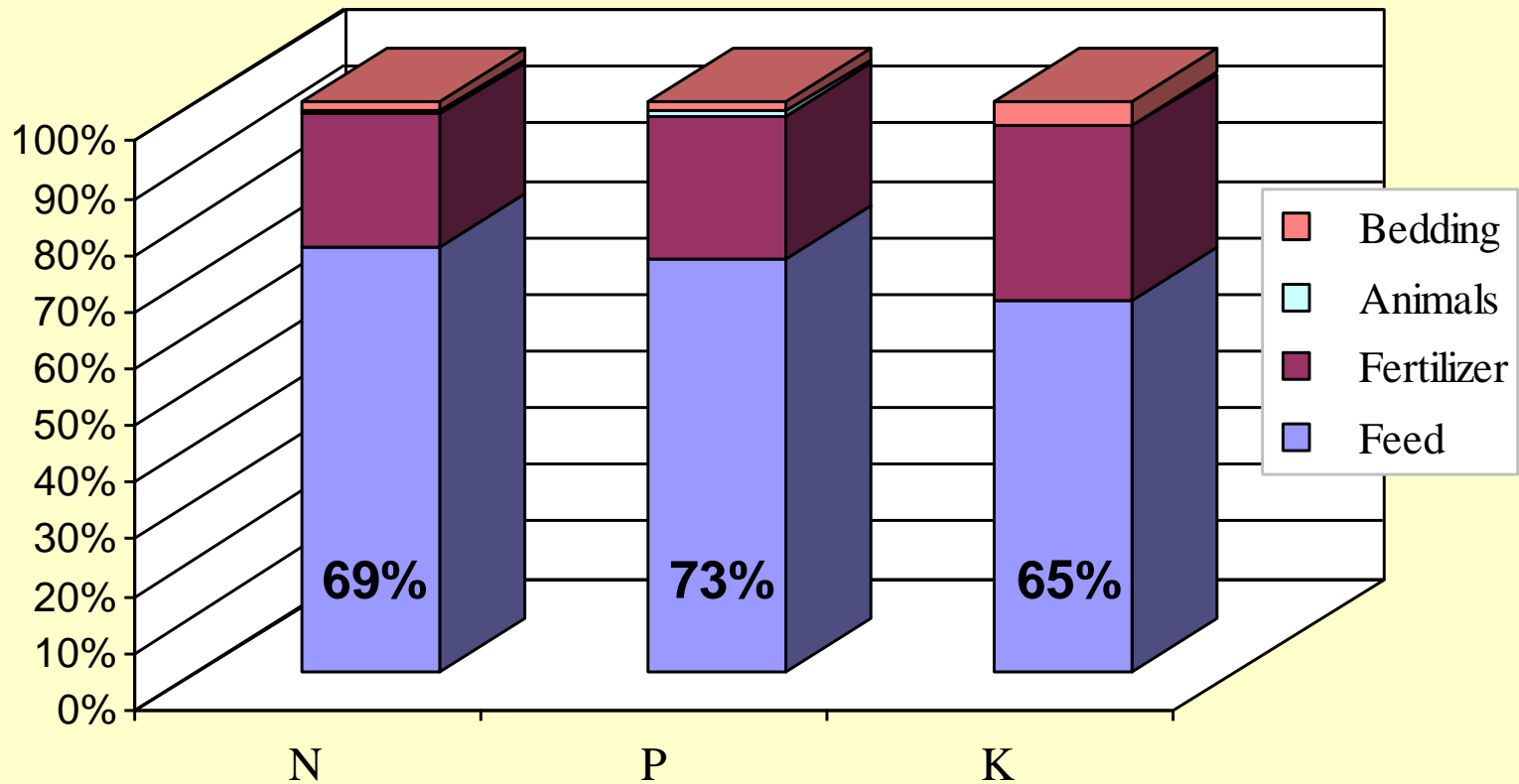


Doug Beegle, Penn State

Manure

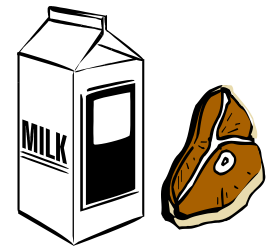
Distribution of N, P and K Imports

Import items (feed, fertilizer, bedding, animals) as a percentage of all annual imports.





Purchased feed and animals



Milk and meat

Cows



Dairy

Farm System

Manure



Soil



Fertilizer

Feed as precisely as possible to known nutrient requirements.

Minimize storage losses.

N-Fixation

Crops



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

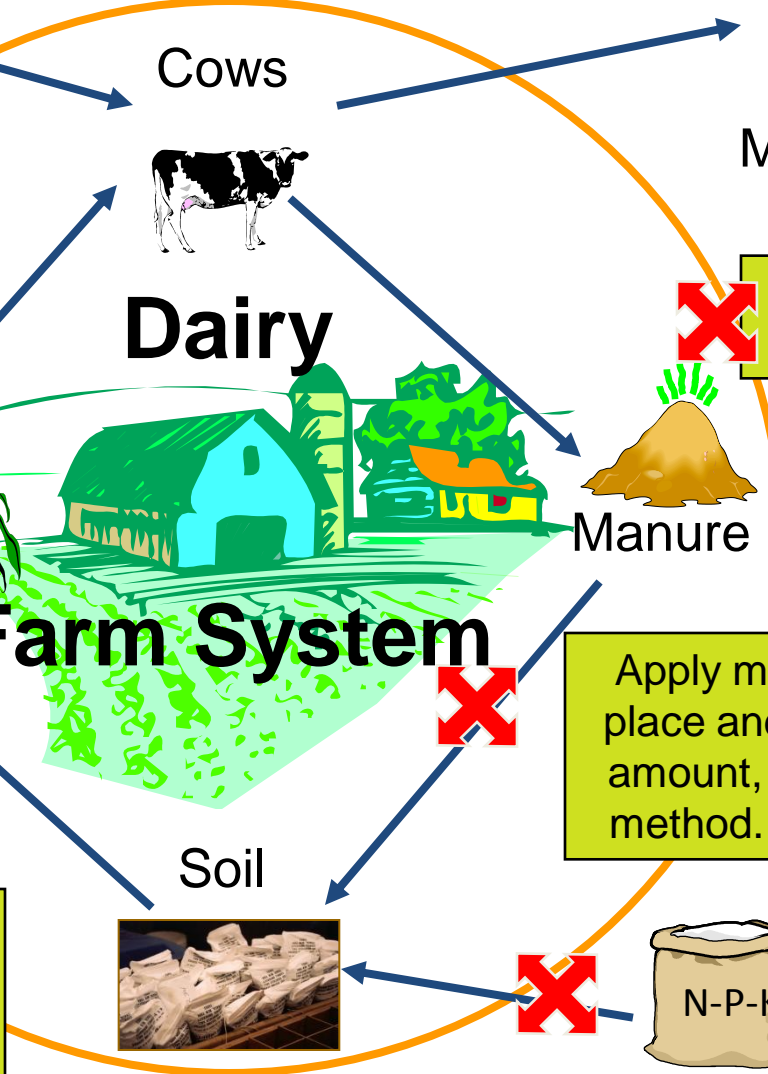


Optimize species selection based on soil & climate characteristics and use optimum rotations.

Manure treatment/export.

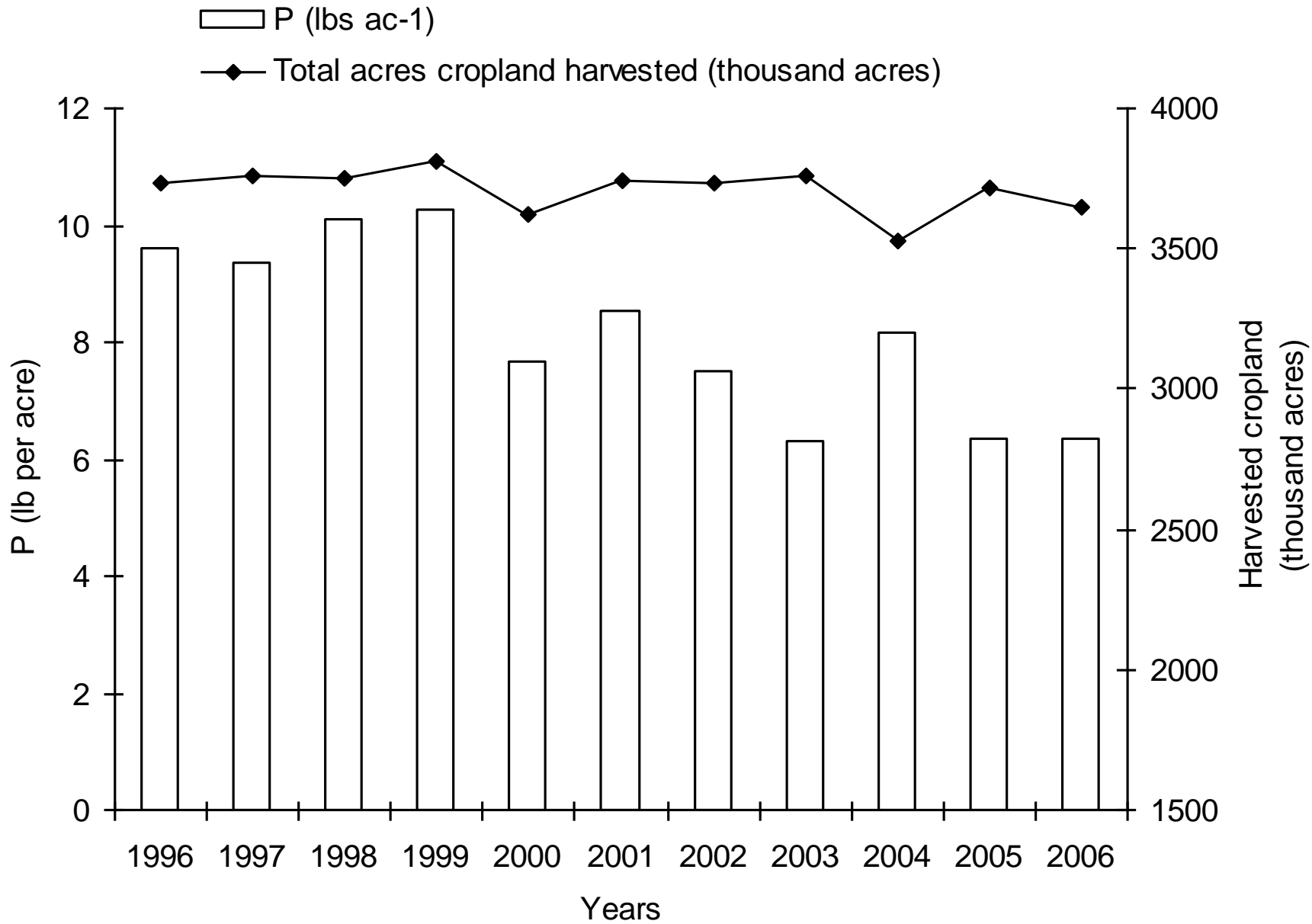
Apply manure at the right place and time, in the right amount, and with the right method. Export if needed.

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



Phosphorus Story in New York

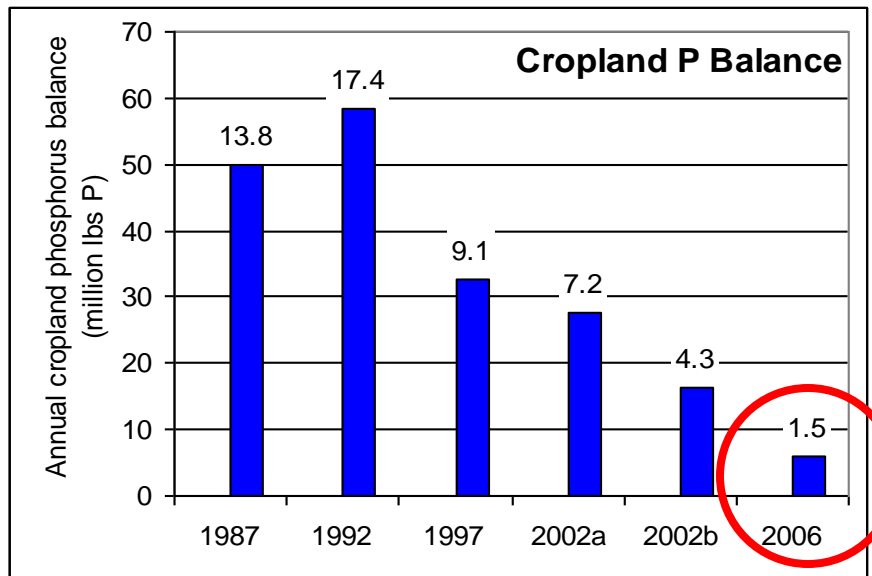
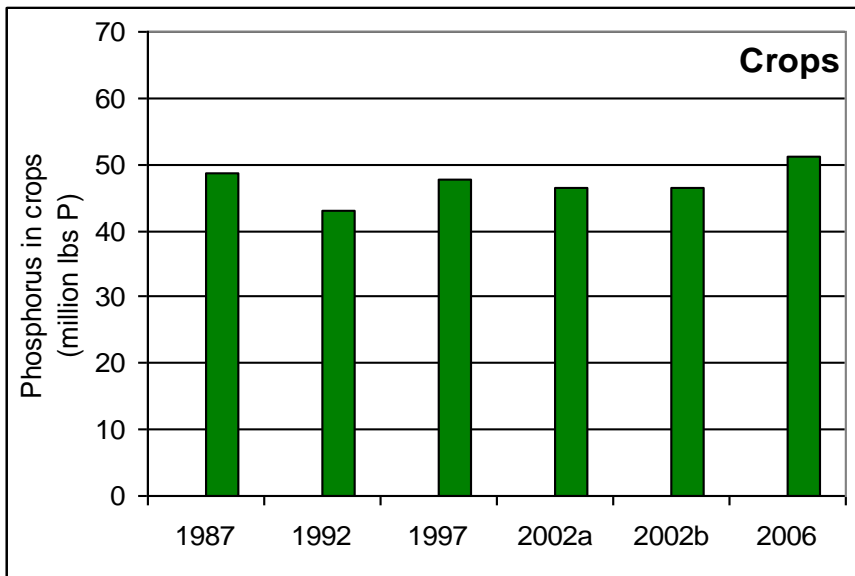
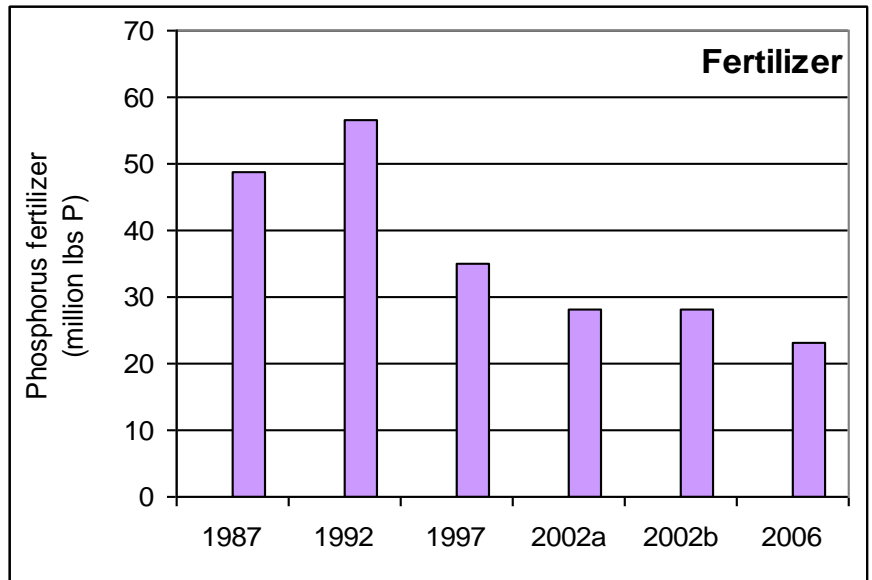
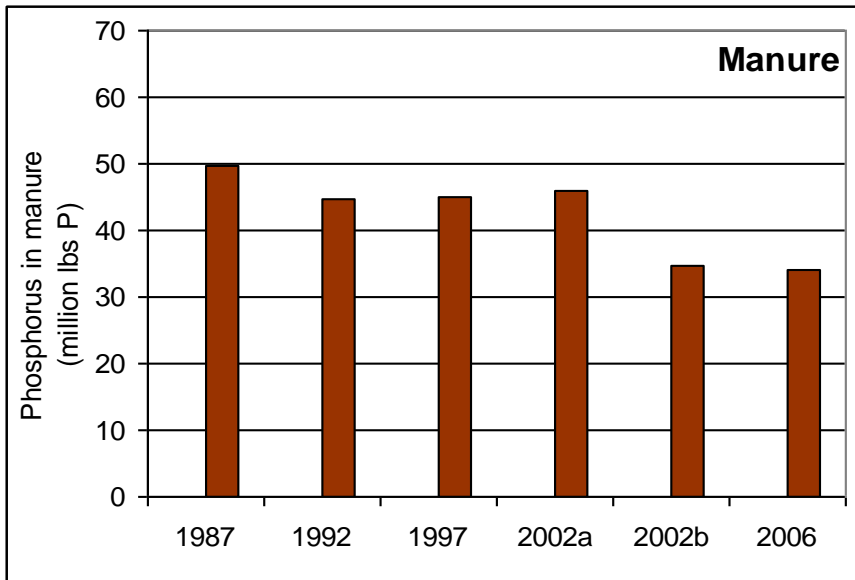
- Farmers made changes:
 - Reduced fertilizer use
 - Reduced P levels in rations
 - More homegrown forages
 - Greater distribution of manure across fields
 - Percent of acres testing above optimal is no longer increasing (35% optimal, 10% above optimal)
- All of these were win-win situations
 - The changes made economic sense
 - Adoption rates have been high



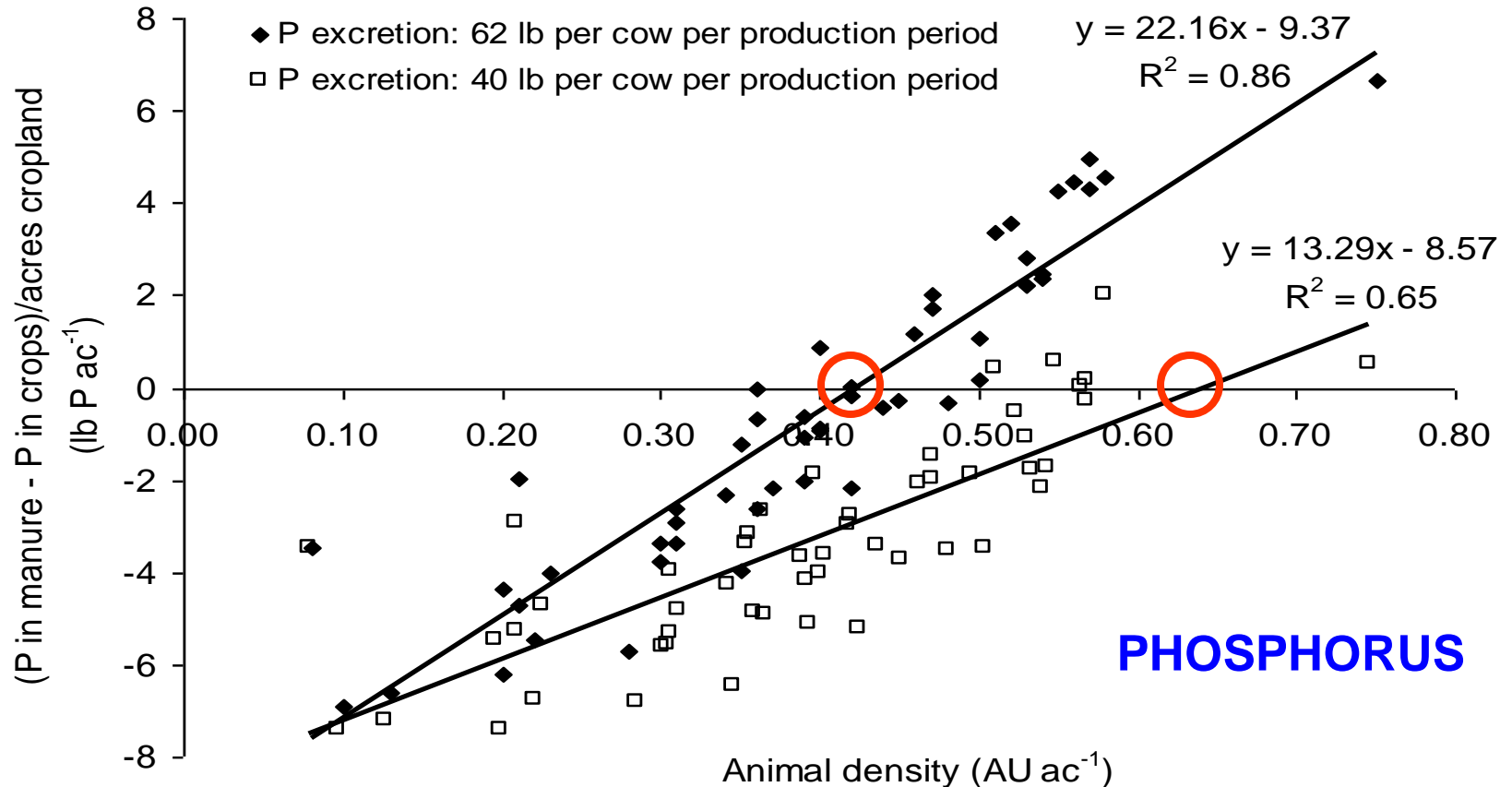
Findings for phosphorus

- Precision feeding reduced P balances (2002 data):
 - State: from +7.2 to +4.3 lb P/acre
 - USW: from +5.5 to +2.4 lb P/acre

Trends over time....NYS

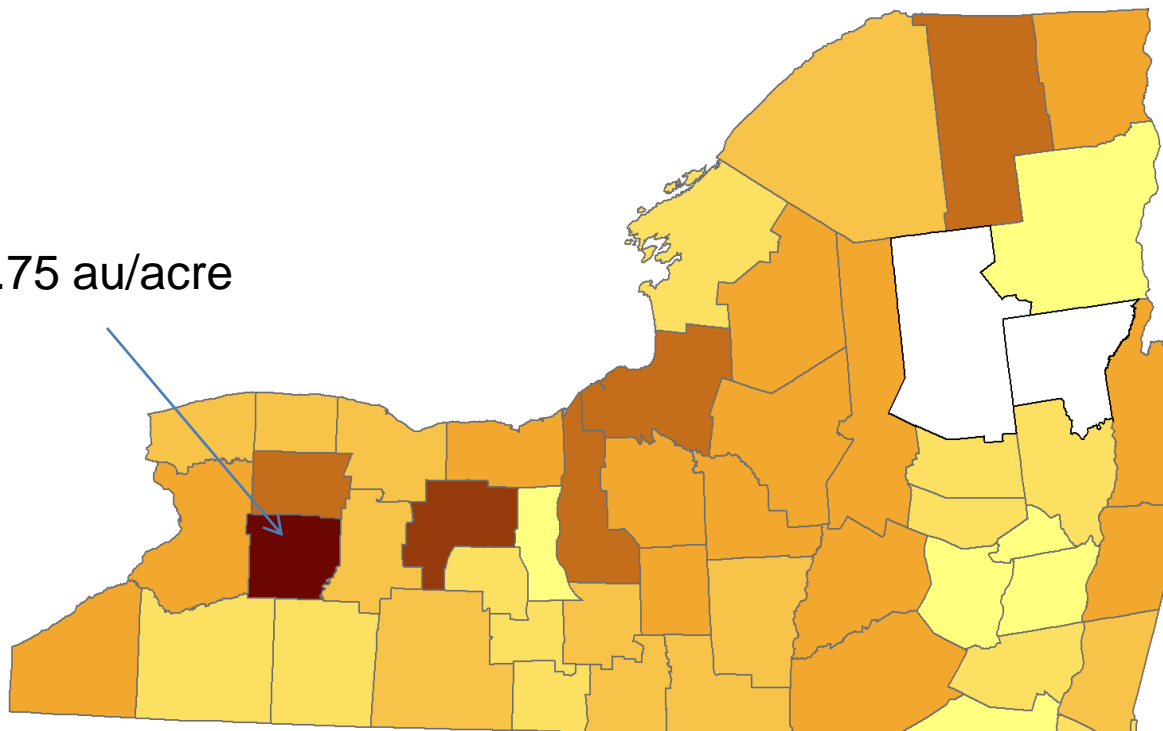


Sustainable animal densities - NYS

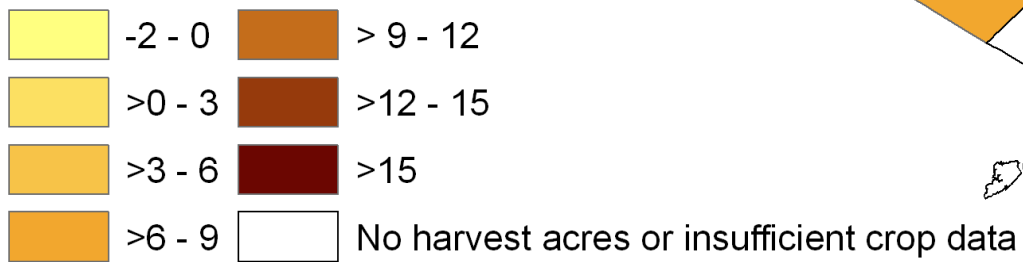


Animal density (animal units per acre) and manure P applied in excess of crop removal for 51 New York State counties (2002 data) with (1) an excretion of 62 lb P per cow per production period, and (2) reduced dairy cow manure P excretion (40 lb per cow per production period) reflecting adherence to the NRC (2001) guidelines for nutrient requirements for dairy cattle.

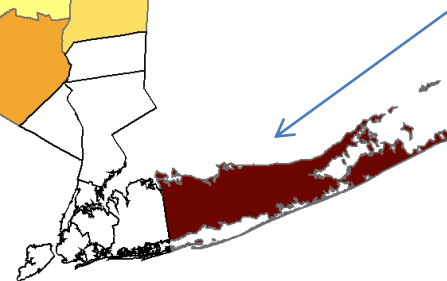
0.75 au/acre



Legend
lbs P per acre



0.08 au/acre



Phosphorus Based Manure Management has Implications for Nitrogen

- When untreated manure is applied to meet crop N needs, P will be over-applied.
- When manure is applied at P removal rates:
 - Manure application rates will need to be lower
 - Less N will be applied
 - Economic incentive:
 - » Hold on to as much as possible
 - Reduce ammonia emissions!

Nitrogen intake & excretion for a dairy cow producing 65 lb of milk/day in a 305-d lactation, 60-d dry period.

Ration CP	Feed N intake	Fecal N	Urinary N	Total N	Total yearly N excretion	Manure N
%	g/d	g/d	g/d	g/d	lbs	lb/lb milk
18.3	590	182	265	447	328	6.87
17.3	550	179	227	407	302	6.26
16.3	526	182	201	383	286	5.89
15.3	493	182	168	350	263	5.38
14.2	468	186	139	325	247	5.00

Calculated using the CNCPS 6.1 model, based on a typical ration of corn silage, alfalfa silage, corn meal, soybean meal, heat-treated soybean meal (SoyPlus), blood meal and a mineral-vitamin mix with a ratio of corn silage to haylage of 59:41 on a dry matter basis.

Larry Chase and Mike van Amburgh, Cornell University

Nitrogen Story

- Improvement in herd nutrition through precision feeding has the potential to:
 - reduce N imports onto the farm.
 - increase N use efficiency of surface applied manure and thus reduce N loss.

BUT

- Such improvements will also reduce the total amount of N excreted and decrease the N:P ratio of the manure....so less N per unit P applied!



For NY dairies:

- Reduce ammonia emissions in the barn
- Reduce ammonia emission in the field (spring incorporation of manure).
- Hold on to the N we have (cover crops to carry over N from one season to the next).
- Bring in nitrogen where needed (legume crops in rotations, shorter rotations)
- Watch animal densities; manure treatment and export (of P) where needed.
- Focus on economic solutions!

Cropland (Net) Balances - NYS

	N in manure	N in fertilizer	N in crops*	N balance	
	(tons)	(tons)	(tons)	(tons)	(lb/ac)
Gross N balance	115,081	69,237	113,973	+70,344	+55
Spring incorporated manure (60% efficiency of manure N; 75% of fertilizer)	45,898	51,928	113,973	-16,147	-13
No incorporation of manure (25% efficiency of manure N; 75% of fertilizer)	<u>19,124</u>	51,928	<u>113,973</u>	-42,921	-34

*Non-legume acres

Manure N : Crop N = 0.17

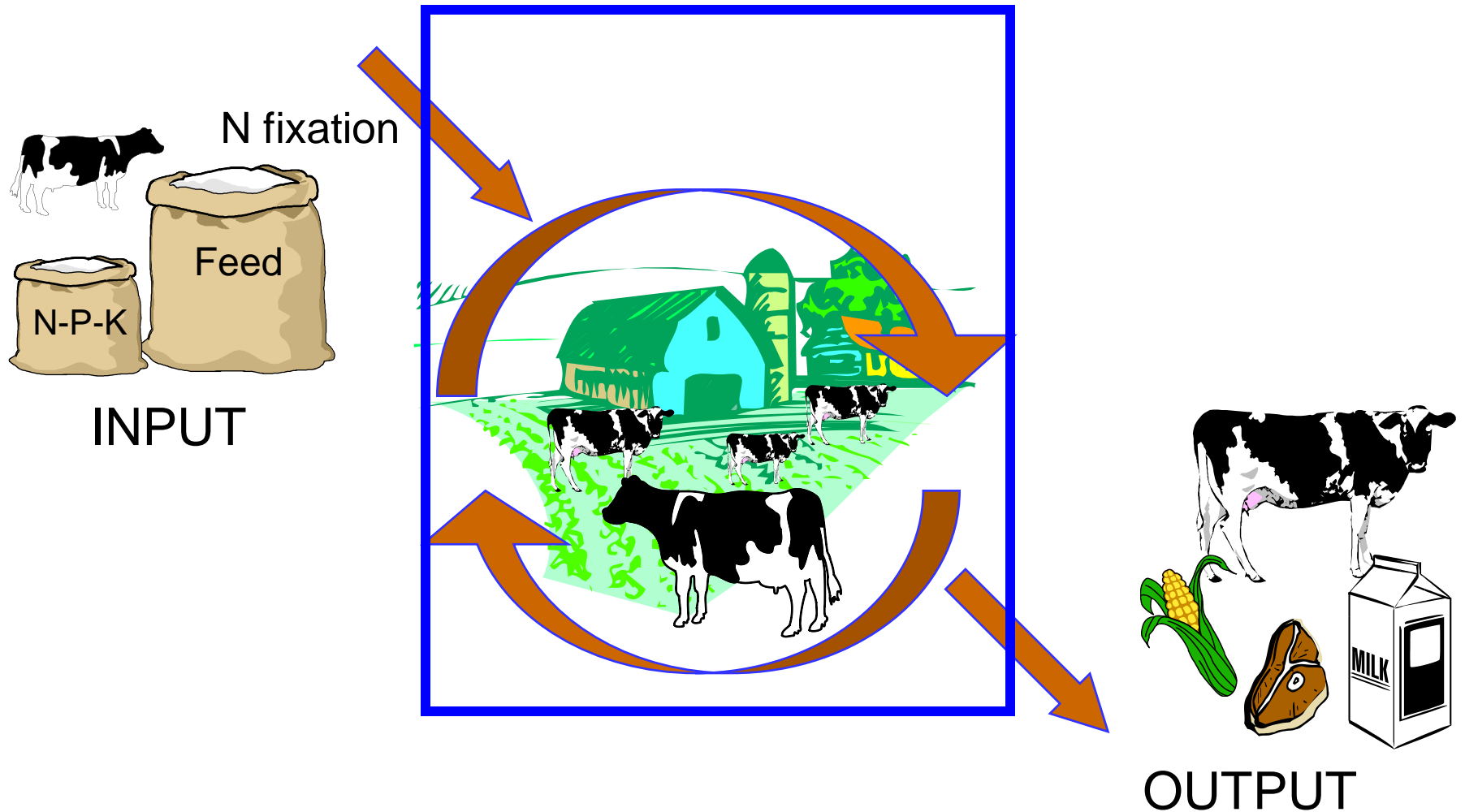
If there is excess N (animal density too high):

- Cover crops for N management are a band-aid for farms that are out of balance due to too high animal densities.
- Building storages is not a solution for farms that do not have the land base to support the animals.
- Manure incorporation to capture ammonia N is shifting an air emission problem to a water quality for farms if there is too much N.

Tools for Systems Evaluation

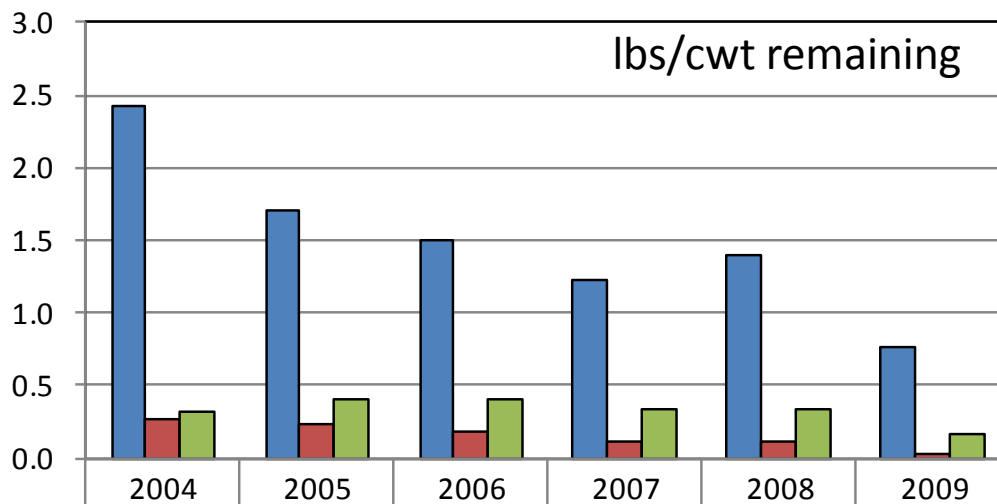
- Precision
 - Feeding
 - Storage management
 - Field management
 - Record keeping (yield, manure and fertilizer applications, soil and manure tests)
 - Adjustment of fertilizer use to supplement on-farm resources – rotation management
 - CSNT; strip trial implementation

Whole Farm Nutrient Balances

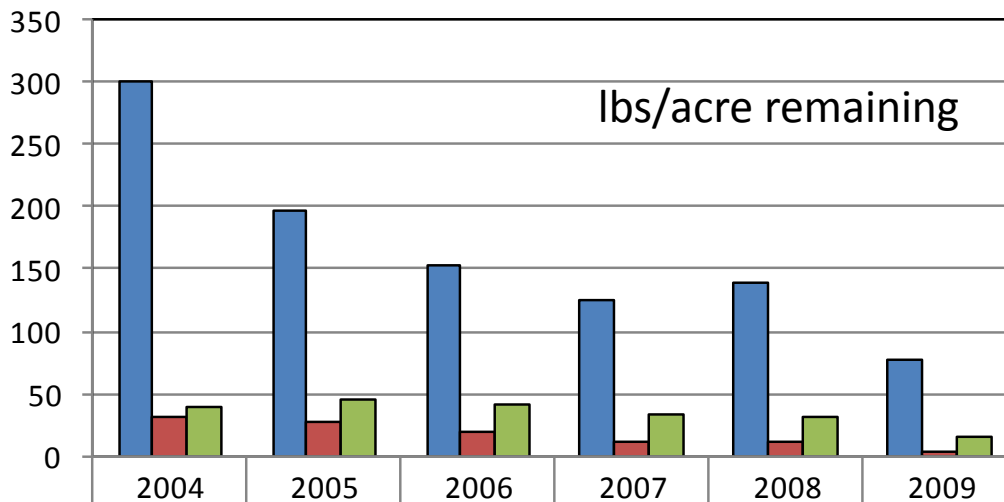


Whole-farm N, P and K nutrient balances

Improvements
reflect
changes
at the
farm level
managing for N, P
and K (S, micros)



■ 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

Sustainability

- Economically viable farms
- Protection of our resources
(soil, water, air)

Evaluate Impact of BMPs
across the whole farm.