Mass Nutrient Balance

Management Tool for Dairy and Livestock Farms

How much N, P and K are imported onto the farm?
How much is leaving the farm in the form of milk, meat, crops, manure export?
How can we make the difference smaller?

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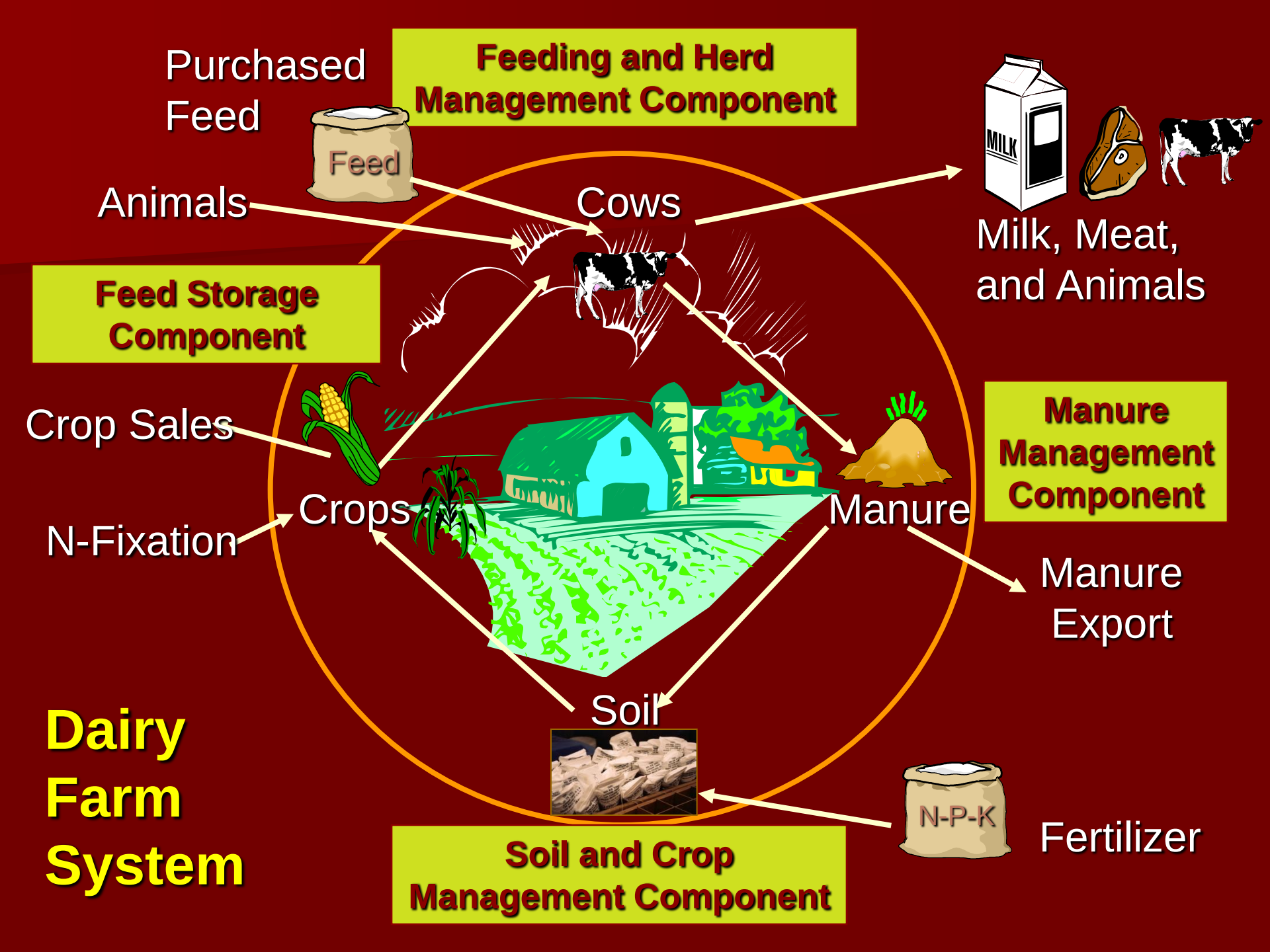
Cornell University Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

What is a Mass Nutrient Balance?


Purchased Feed
Feeding and Herd Management Component
Feed
Animals
Cows
MILK
Milk, Meat, and Animals
Feed Storage Component
Crop Sales
Crops
Manure
Manure Management Component
N-Fixation
Manure Export
Soil
Dairy Farm System
N-P-K
Fertilizer
Soil and Crop Management Component

Mass Nutrient Balances

Why measure farm mass nutrient balances?

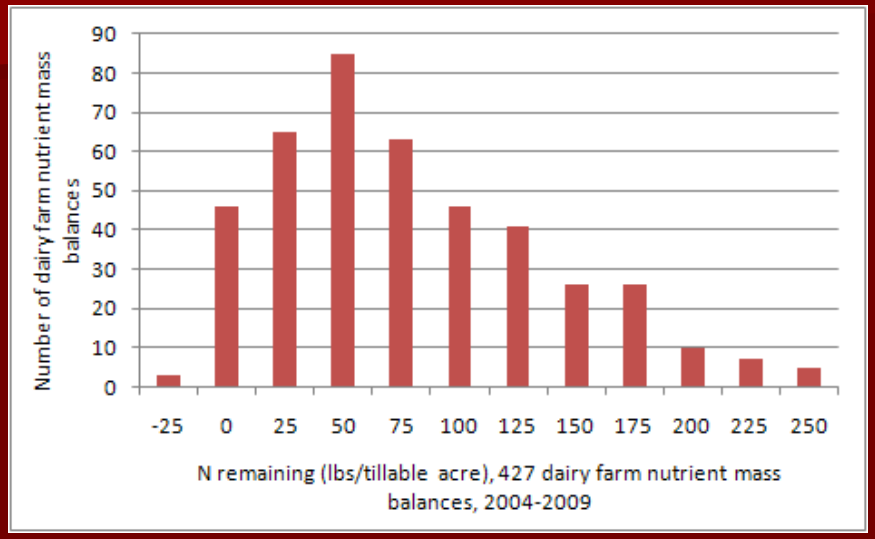
Imbalances can cause…

- Economic losses (low nutrient use efficiency, unnecessary expenses)
- Annual nutrient losses to the environment (nitrogen)
- Increases in soil nutrient reserves beyond crop needs increasing the risk for future environmental losses (phosphorus)
- Nutrient "mining" from cows and soil below levels needed for optimum production

Imbalances can cause…

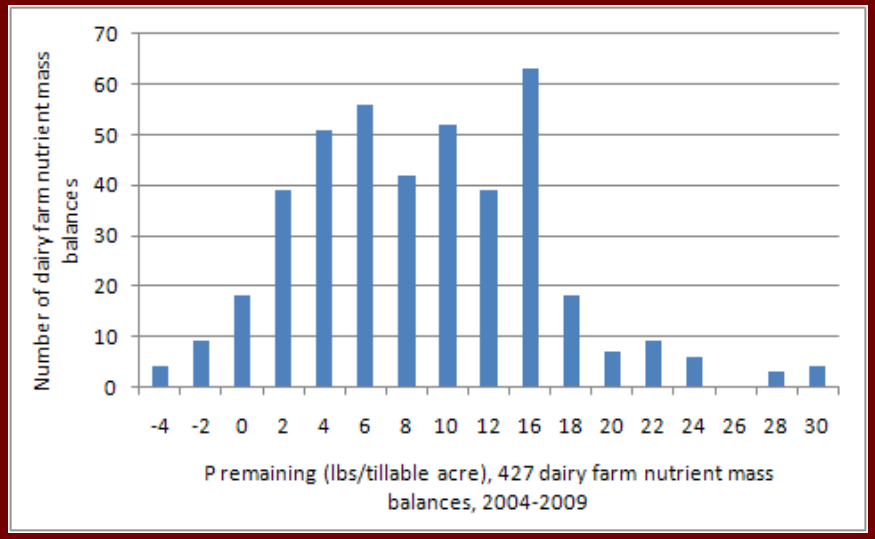
Because of the biological inefficiencies of animal and crop production, positive mass nutrient balances are common and both agronomic and economically desirable. However, large positive balances signal inefficiencies in nutrient use and risk for environmental losses.

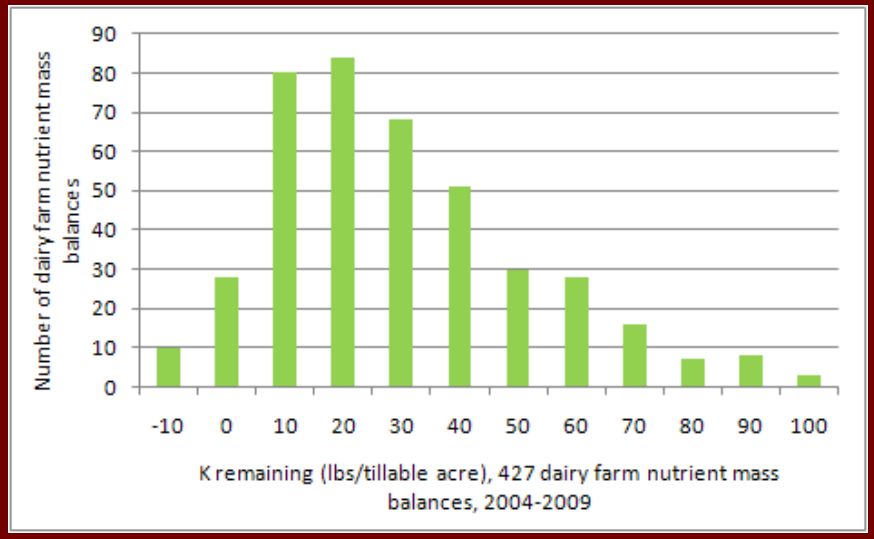
Most dairies import more nutrients than they export



Current dataset (427 balances):

- 93% farms had positive N balance
- 88 % farms had positive P balance
- 91% farms had positive K balance





…..so why measure farm nutrient mass balance?

A MNB Analysis can be a diagnostic tool:

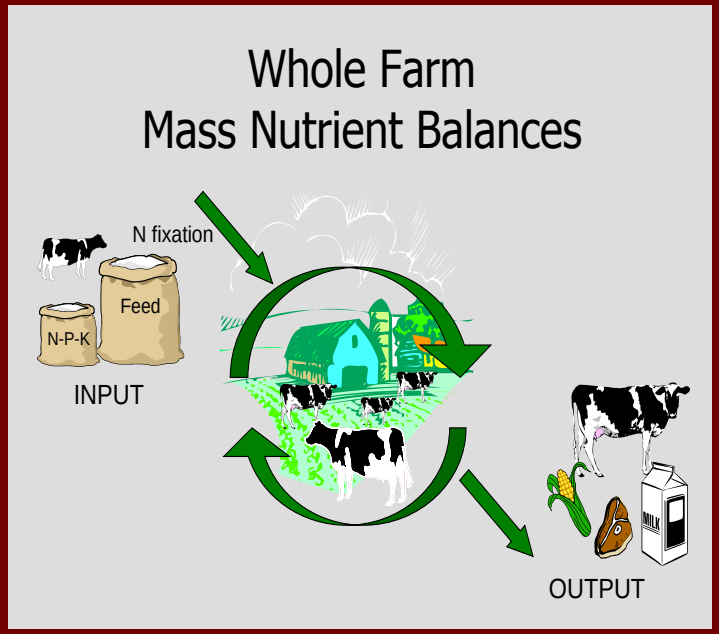
- Identify opportunities for more efficient nutrient use

Mass nutrient balances can play a key role in providing benchmarks for monitoring farm nutrient management performance:

- Increase awareness of individual mass balances
- Measure progress over time

Using the mass nutrient balance analysis as a diagnostic tool

- Parameters affecting mass balances are generally the same from farm to farm.
- The magnitude of influence for each factor is specific to the individual farm.



Using the mass nutrient balance analysis as a diagnostic tool

Consider:

- Farm characteristics
- Import and export distribution
- Comparison to peers
- Comparison to past performance

What do farm characteristics tell us about the business ?

DIAGNOSTICS							
Mature Cows	984			Acres receiving manure (% tillable)	77%	per manure acre	per tillable acre
Animal Units	1,994			Ratio of Cows to Heifers	1 to 0.96		
Milk production/cow/year (lbs)	29,441			Animal Density (animal units/acre)		1.85	1.41
Total legume acres	171			Milk Production (lbs/acre)		26,824	20,546
Proportion of Purchased and Farm Produced Feed							
Purchased Feed (% total feed dry matter)	38%			Farm Produced Feed (% total feed dry matter)			62%
Purchased Forage (% total feed dry matter)	4%			Farm Produced Forage (% total feed dry matter)			62%
Purchased Grain (% total feed dry matter)	34%			Farm Produced Grain (% total feed dry matter)			0%
Nutrients Remaining	N	P	K	Production Efficiency	N	P	K
Per animal unit (lbs)	105	10	47	Feed Use Efficiency (Milk/Feed) %	22	28	11
Per mature cow (lbs)	212	19	96	Nutrients imported per cwt milk sold	1.31	0.17	0.50
% [(Imports-Exports)/Imports]	55	39	66	Nutrients remaining per cwt milk sold	0.72	0.07	0.32

OTHER NITROGEN CONTRIBUTIONS

Source	tons/year	lbs/tillable acres
Legume N Fixation	37.34	53
Atmospheric N Deposition	5.64	8
Total other N imports	42.98	61
Total N Remaining	147.49	209
Total N Remaining/au (lbs)	148	
Total N Remaining/cow (lbs)	300	
% Total N Remaining	64%	

Legume fixation is an important source of N on many farms, but there are many uncertainties associated with this estimate. The N fixation estimate is based on the farm total legume production. If the crop is >90% legume, the estimated N fixation is 60% of the crop N content. For crops with 90% or less legume, the estimated N fixation is 36% of the crop N content.

Atmospheric nitrogen deposition is estimated at 8 lbs per total farm acre.

What import/export are largest?

DISTRIBUTION OF IMPORTED NUTRIENTS

Source	N	P	K
	% of imports		
Feed	89%	99%	72%
Fertilizer	11%	1%	28%
Animals			
Bedding & other imports	0%	0%	

DISTRIBUTION OF EXPORTED NUTRIENTS

Source	N	P	K
	% of exports		
Milk	89%	87%	94%
Animals	7%	10%	2%
Crops	2%	1%	3%
Manure & other exports	1%	1%	2%

What import/export are largest?

Itemized N, P, K imports			
Import % from purchased feed	% N	% P	% K
Canola Meal	17%	25%	10%
Corn Meal	9%	16%	6%
Hi Protein mix	45%	35%	38%
Low protein mix	8%	7%	6%
Heifer protein mix	2%	2%	2%
prefresh protein mix	3%	2%	2%
calf grain	1%	1%	1%
calf mineral		3%	0%
haylage			0%
dry hay	0%	0%	0%
wheat straw	1%	1%	3%
Import % from purchased fertilizers	% N	% P	% K
potash			27%
32% liquid N	11%		
Custom fert	0%	1%	2%

Use peer-comparisons to identify areas of concern/improvement

Farm data and N balance factors sorted by N remaining/tillable acre

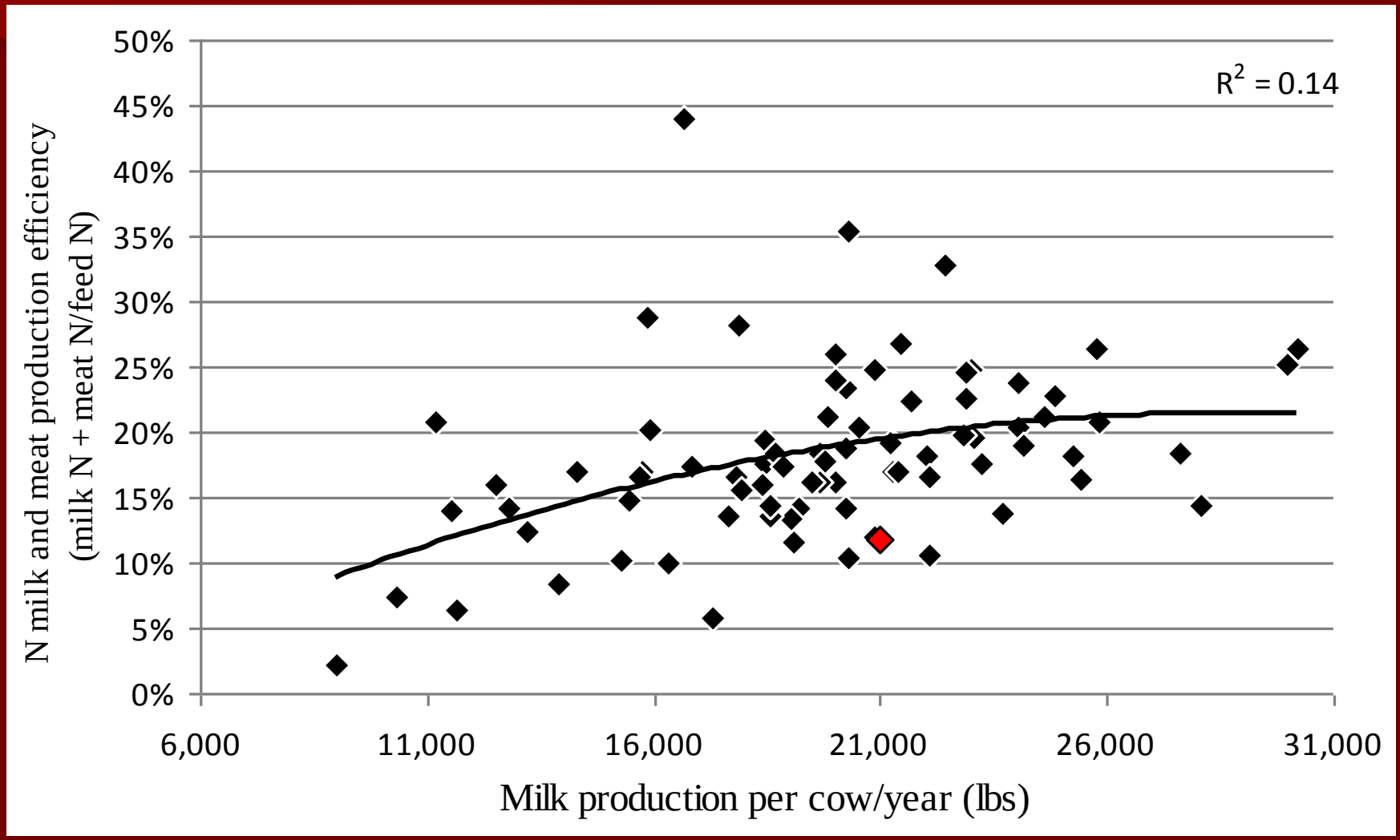
Item	Example Farm	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Nitrogen remaining (lbs/acre)*	310	less than 11	11 to 53	53 to 105	more than 105
Number of farms		21	21	21	20
Business Size & Production					
Mature cows	145	80	137	509	509
Animal units	295	160	279	1,022	982
Animal density (animal units/acre)	1.28	0.41	0.59	0.77	1.09
Milk Sold (lbs/cow)	21,000	16,547	19,007	21,391	22,020
Milk Sold (lbs/acre)	13,239	3,786	5,823	8,819	12,435
Tillable acres	230	413	449	1,069	853
% purchased feed (% of total feed)	64%	13%	20%	27%	42%
% farm produced forage (% of total feed)	36%	79%	74%	69%	56%
% Mature cattle	71%	68%	68%	71%	72%
% Tillable acres receiveing manure	100%	54%	68%	68%	83%
Nitrogen Mass Balance					
Tons N remaining *	35.66	(0.48)	6.90	43.52	71.52
Lbs N remaining/acre receiving manure*	310	(2)	56	118	213
Lbs N remaining/tillable acre*	310	(2)	33	76	166
Lbs N remaining/au*	242	(5)	64	109	156
% N remaining (import-export/import)*	80%	-37%	47%	58%	66%
Total N Remaining (lbs/tillable acre)**	320	42	71	110	210

Can you identify areas of concern on this farm?

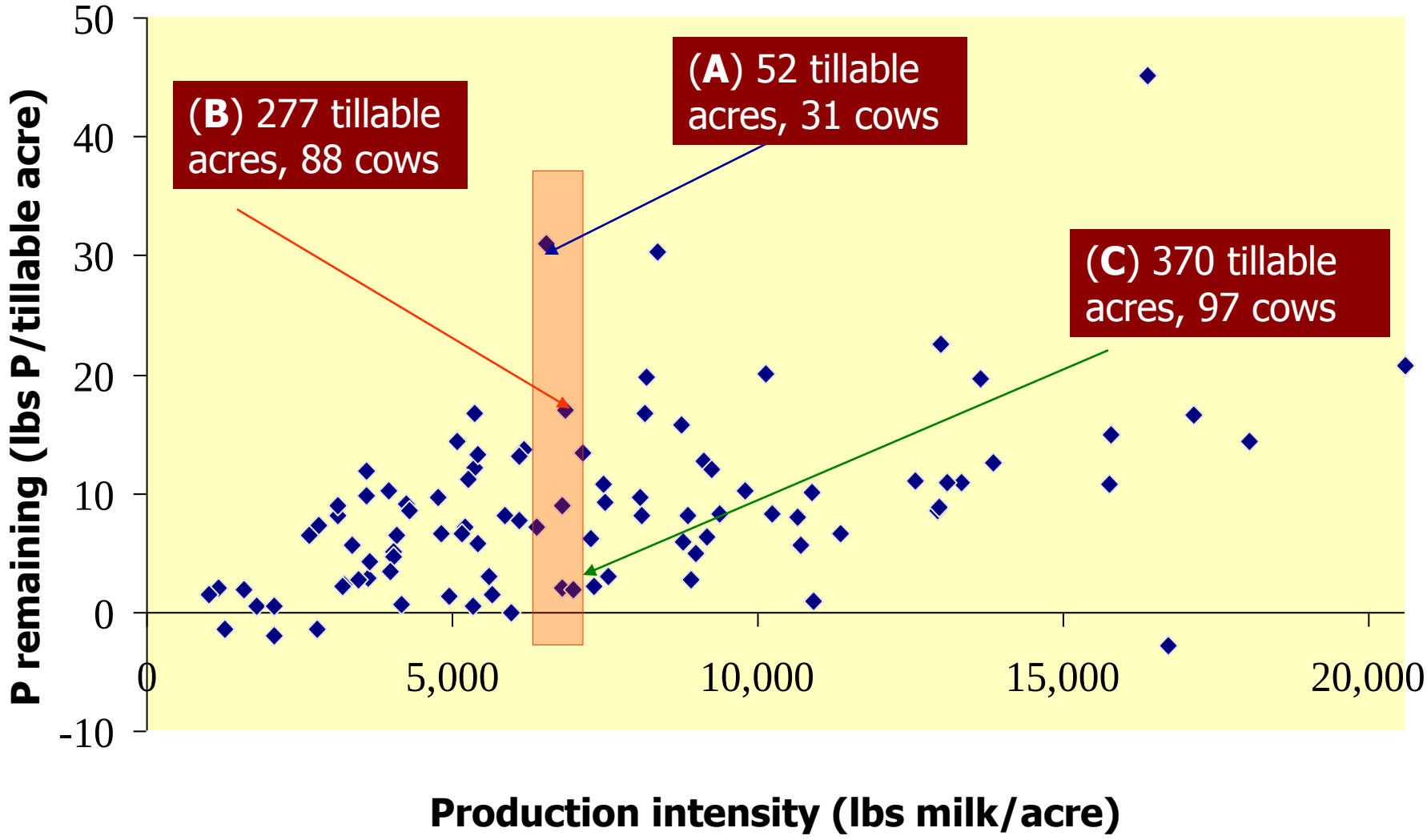
145 acres 21% CP haylage
85 acres 27% CP pasture

Efficiency Measures					
N imports/cwt milk sold	2.94		1.39	1.67	2.16
N exports/cwt milk sold	0.60		0.73	0.68	0.75
N remaining/cwt milk sold	2.34	(0.07)	0.67	0.99	1.41
N feed use efficiency milk [milk N/total feed N]	10%	15%	16%	18%	17%
NFUE milk&meat[(milk N+meat N)/total feed N]	12%	18%	17%	20%	19%
Whole farm ration CP%	15%	15%	15%	16%	17%
Farm produced feed N (lbs N/tillable acre)	341	140	157	149	209
Distribution of imported N					
N from purchased feed (lbs N/tillable acre)	328	24	54	100	210
N from purchased fertilizer (lbs N/tillable acre)	60	9	20	34	52
N from N fixation (lbs N/tillable acre)	-	33	26	25	29
N from purchased animals (lbs N/tillable acre)	-	0	0	1	2
N from bedding (lbs N/tillable acre)	1	0	1	1	2
Distribution of exported N					
N from milk sales (lbs N/tillable acre)	69	20	31	46	65
N from animal sales (lbs N/tillable acre)	10	4	3	5	7
N from crop sales (lbs N/tillable acre)		11	7	5	3
N from manure / compost (lbs N/tillable acre)	-	2	-	5	24

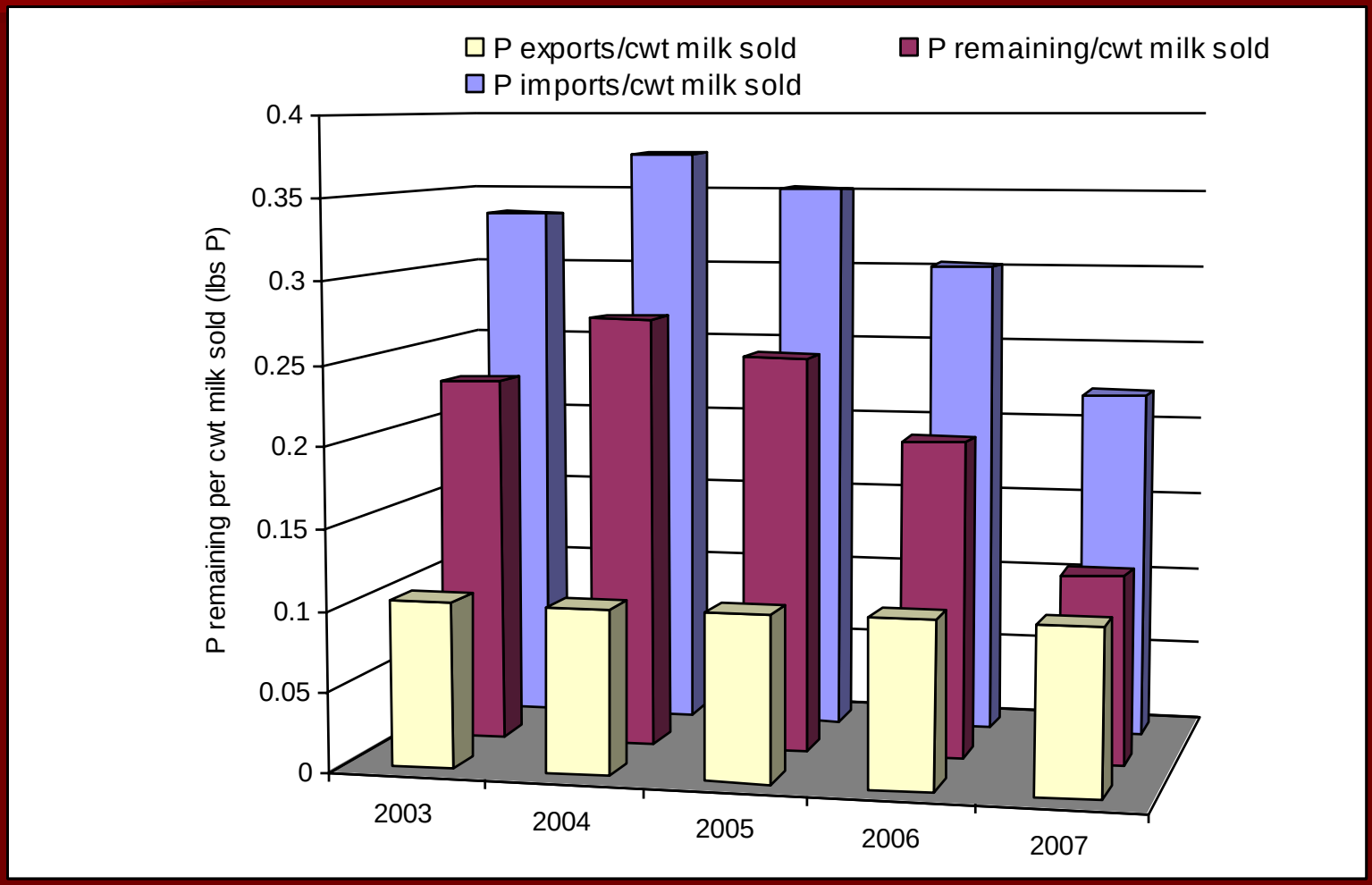
Comparisons within production group: N meat and milk production efficiency



P remaining/tillable acre compared to production intensity (lbs milk/acre)



Progress?
Comparisons to previous years



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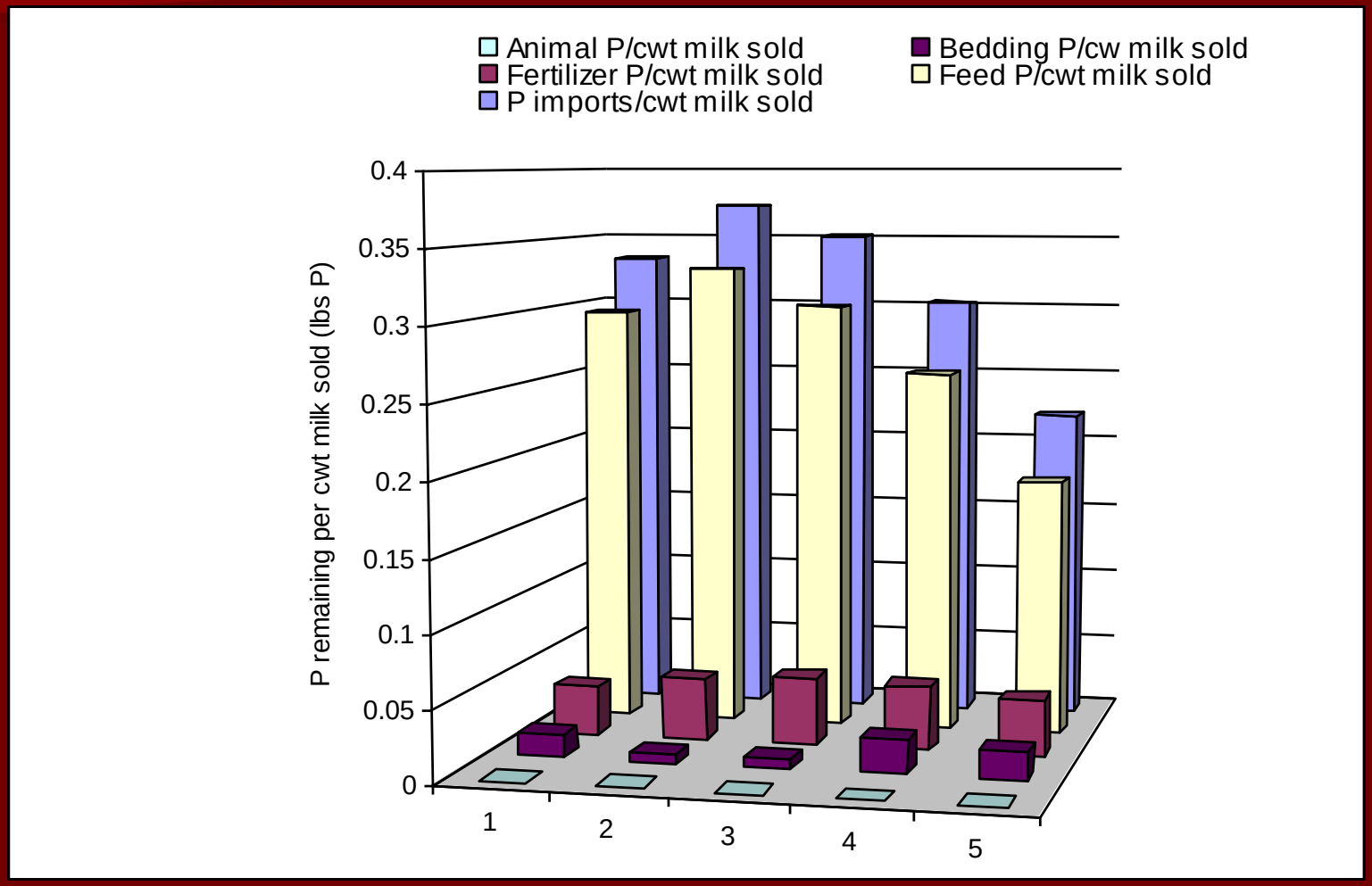
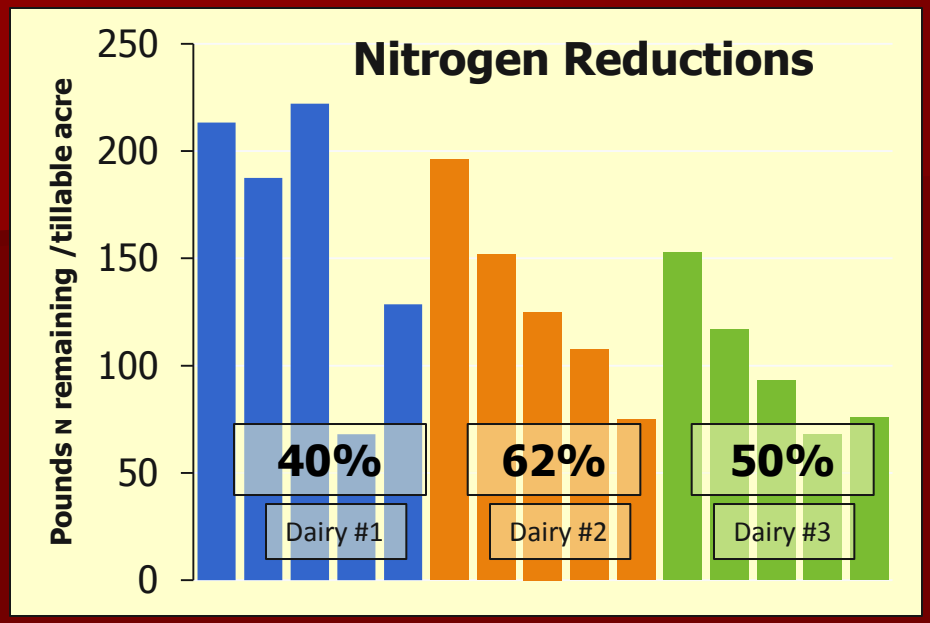
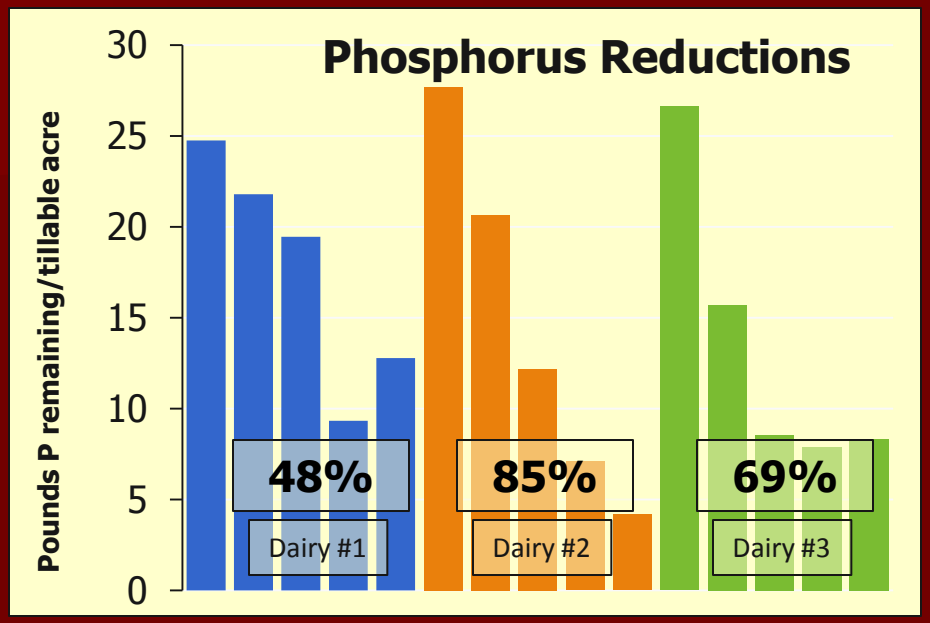
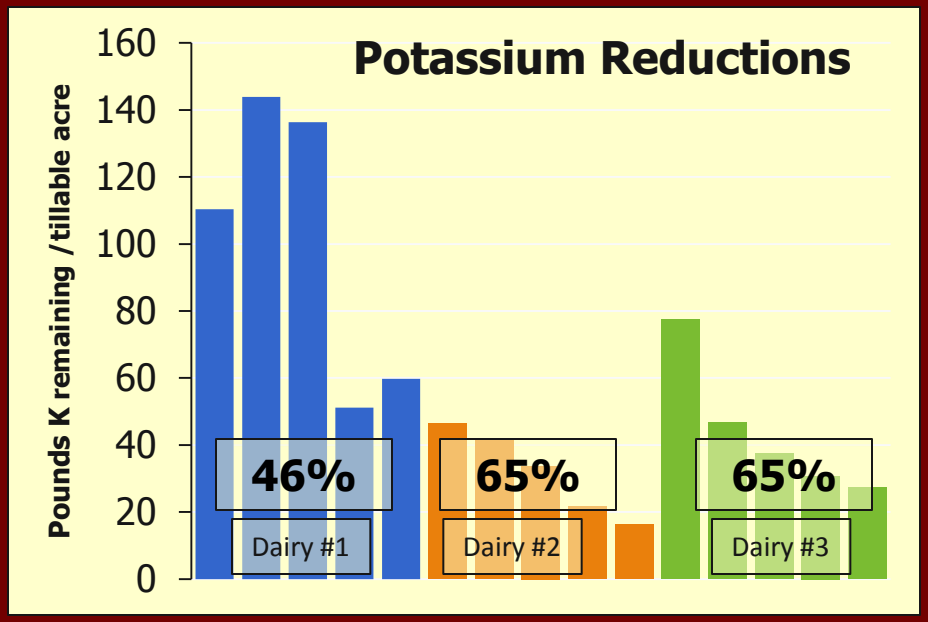


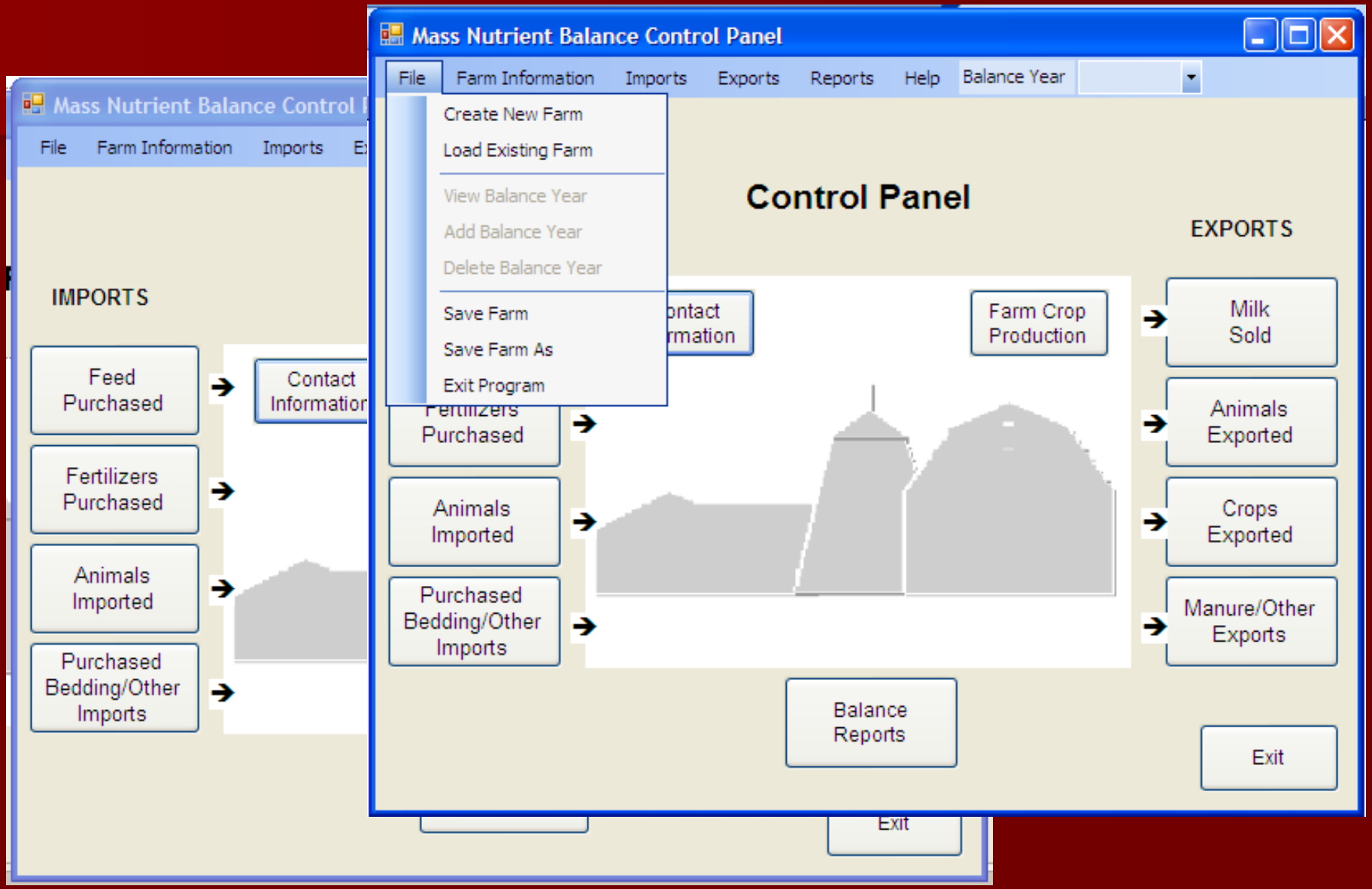
Tracking balances on an annual basis



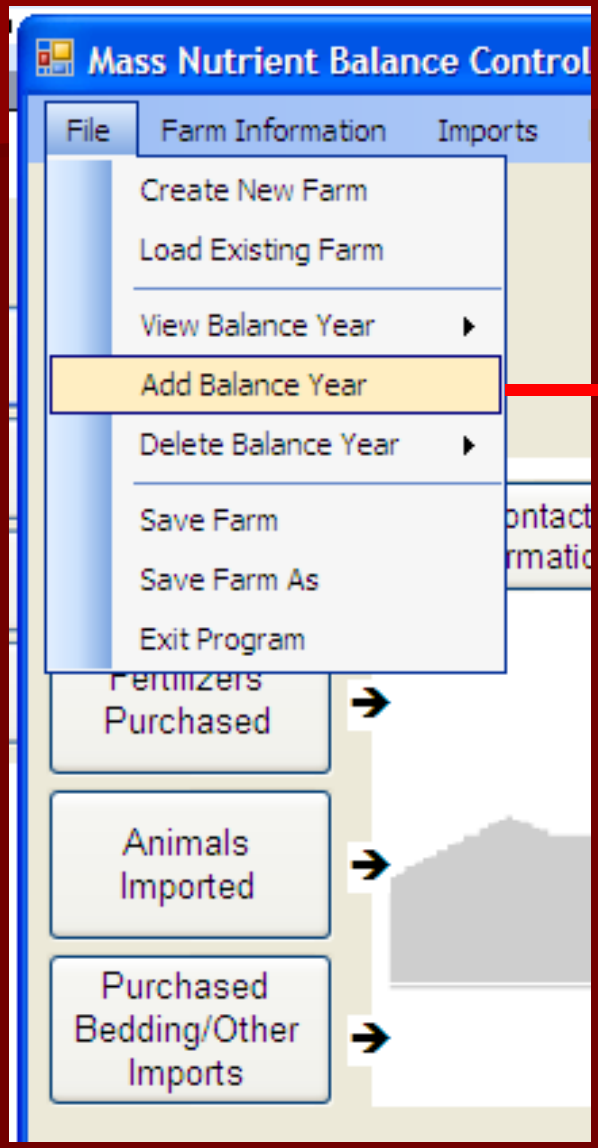


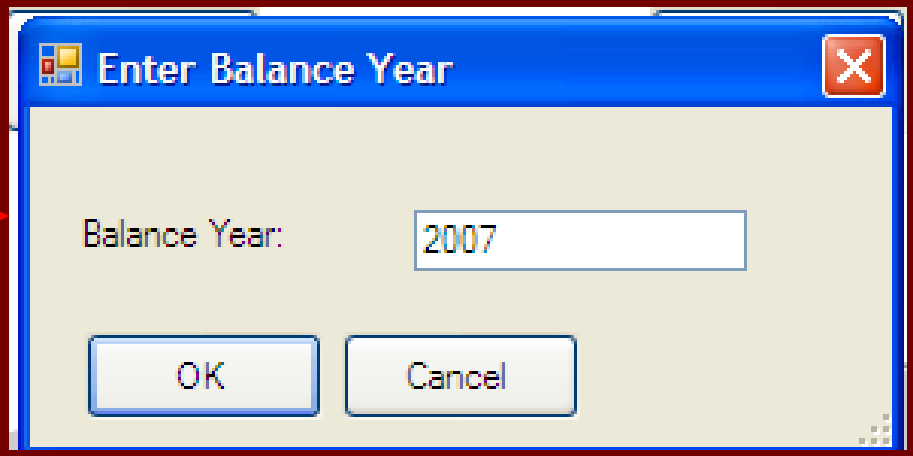


Tool: Mass Nutrient Balance Software



Monitor progress with multiple farm years





Mass Nutrient Balance

Tool to answer the following questions:

- How much N, P and K do I import onto the farm?
- How much N, P, and K do I export from my farm?
- What is the balance in terms of nutrients used per cwt milk or applied per acre cropland?
- How do my balances compare to peer farms and what can I do to be more efficient with the nutrients?

Mass Nutrient Balance

- Agronomy Fact Sheet # 25:
  - Mass Nutrient Balance Software

Cornell University
Nutrient Management Spear Program

SEARCH: go

NMSP Cornell more options

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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 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 see our latest (2/15/2011) Program Report.

News RSS

- 12/17/10: New Student Intern Impact Story: Joseph Foster.
- 12/03/10: New value of manure calculator and tutorials added to the: Nutrient Management Curriculum.
- 11/17/10: New whole farm mass nutrient balance software: MNB_1.0.
- 10/28/10: Latest Additions to the Agronomy Fact Sheets Series: #55: Tissue Testing for Corn, Alfalfa and Soybeans, and #56: Winter Triticale Forage.
- 10/2/10: New Story: Manure Expo Highlights (Manure Manager Magazine).
- 9/21/10: Webcast: Novel Approaches to Manure Application in No-Till (Livestock and Poultry Environmental Learning Center).
- 5/16/10: New York Corn Systems Cover Crop Survey: For Farmers with Experience *with* Cover Crops or For Farmers *without* Experience with Cover Crops (Print, Complete and Mail).

Featured Links

- Cornell Nutrient Guidelines for Field Crops
- Agronomy Factsheets
- Impact Statements
- Nutrient Management Tutorials
- Nitrogen Management on Dairy Farms

Events

2011 Northeast Region CCA Conference
November 29-December 1, 2011. Register by November 5 for an early registration discount.

Photo Gallery

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