N and P Management

Pasture Systems and Watershed Management Research Unit Mission

Conduct research leading to the development of land, water, plant, and animal management systems, which insure the profitability and sustainability of northeastern grazing and cropping enterprises while maintaining the quality of ground and surface waters.

PSWMRU CRIS Projects

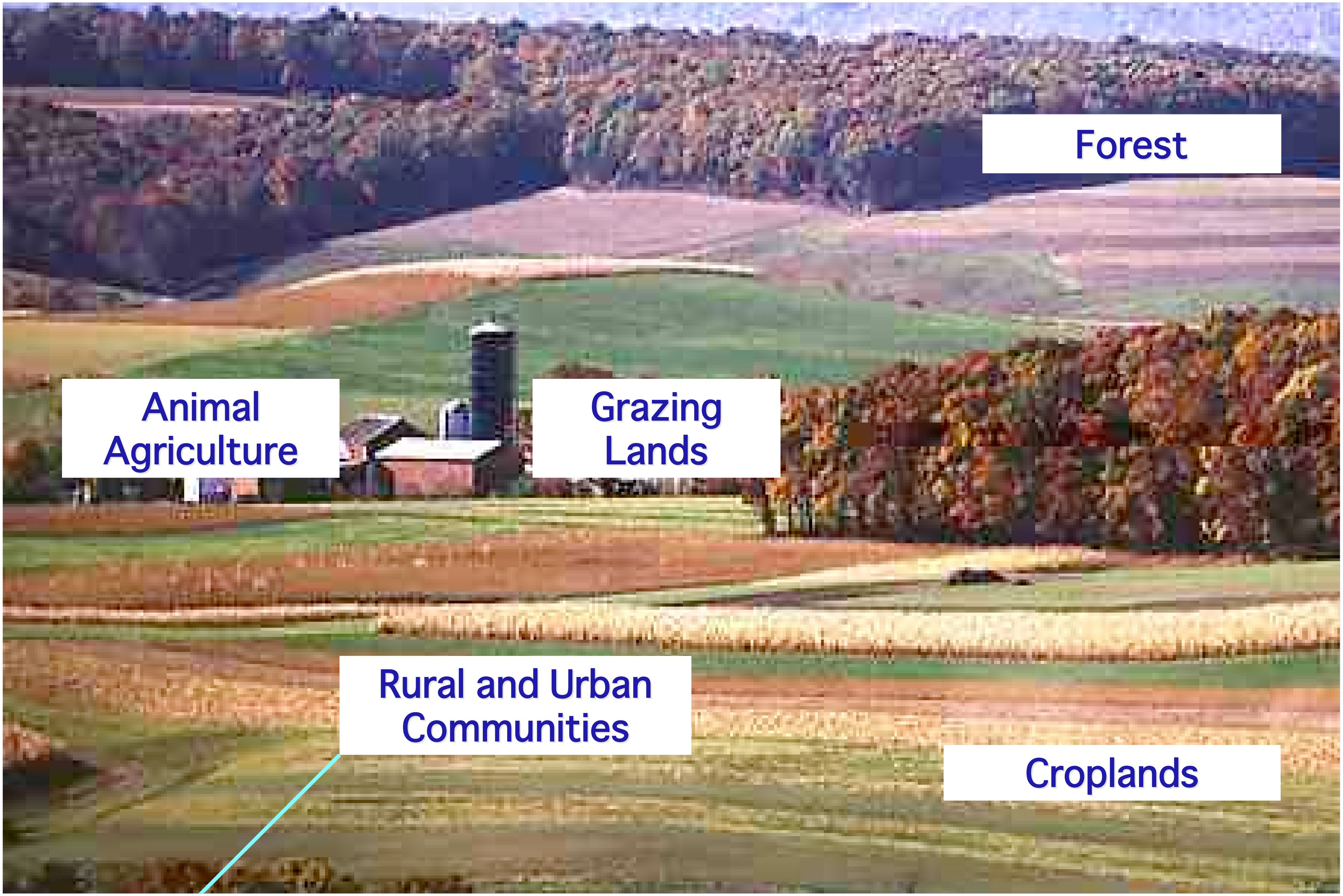
- ✓ Integrated Farming Systems
- ✓ Grassland Ecology
- ✓ Nutrient Management

Nutrient CRIS Objectives _ Basic

- ✓ Quantify P, N, and C cycling in soils impacted by fertilizer, manure, crop and grazing management
- ✓ Develop methodology to link critical source areas and transport pathways of P and N by relating soil nutrient levels to losses in surface runoff and leachate and delineating hydrologic processes controlling nutrient loss from watersheds

Nutrient CRIS Objectives - Applied

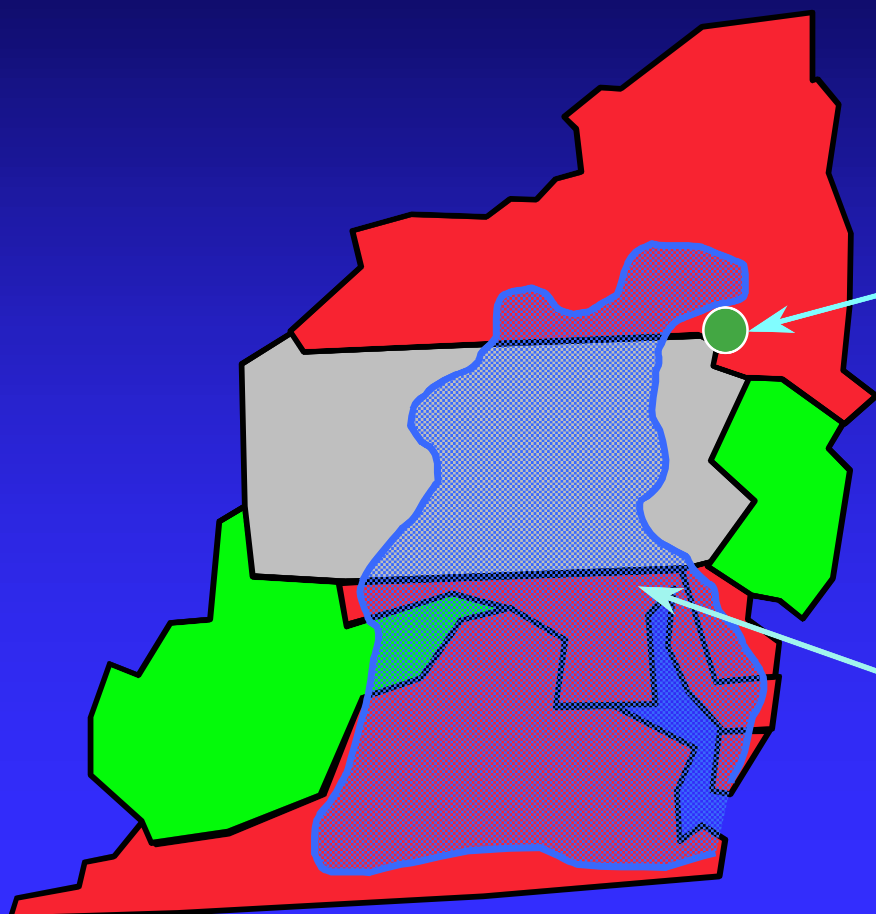
- ✓ Develop and apply models and indices to assess and rank site vulnerability to nutrient loss
  - P and N indices
- ✓ Evaluate best management practices aimed at minimizing nutrient transfers from agricultural lands to water.
  - P sequestering agents
  - Ash pavement

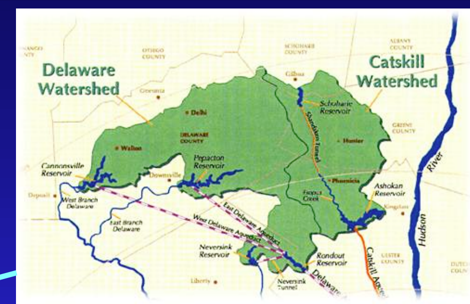

Forest
Animal Agriculture
Grazing Lands
Rural and Urban Communities
Croplands

Why the Concern ?

- ✓ Nitrates in ground waters
  - Health risk to infants
- ✓ Eutrophication
  - Algae & weed growth and blue-green toxins
  - Coarse fish numbers and fish kills
  - Chlorination of eutrophic drinking waters
    - ✓ carcinogenic risk.

Impacted Watersheds



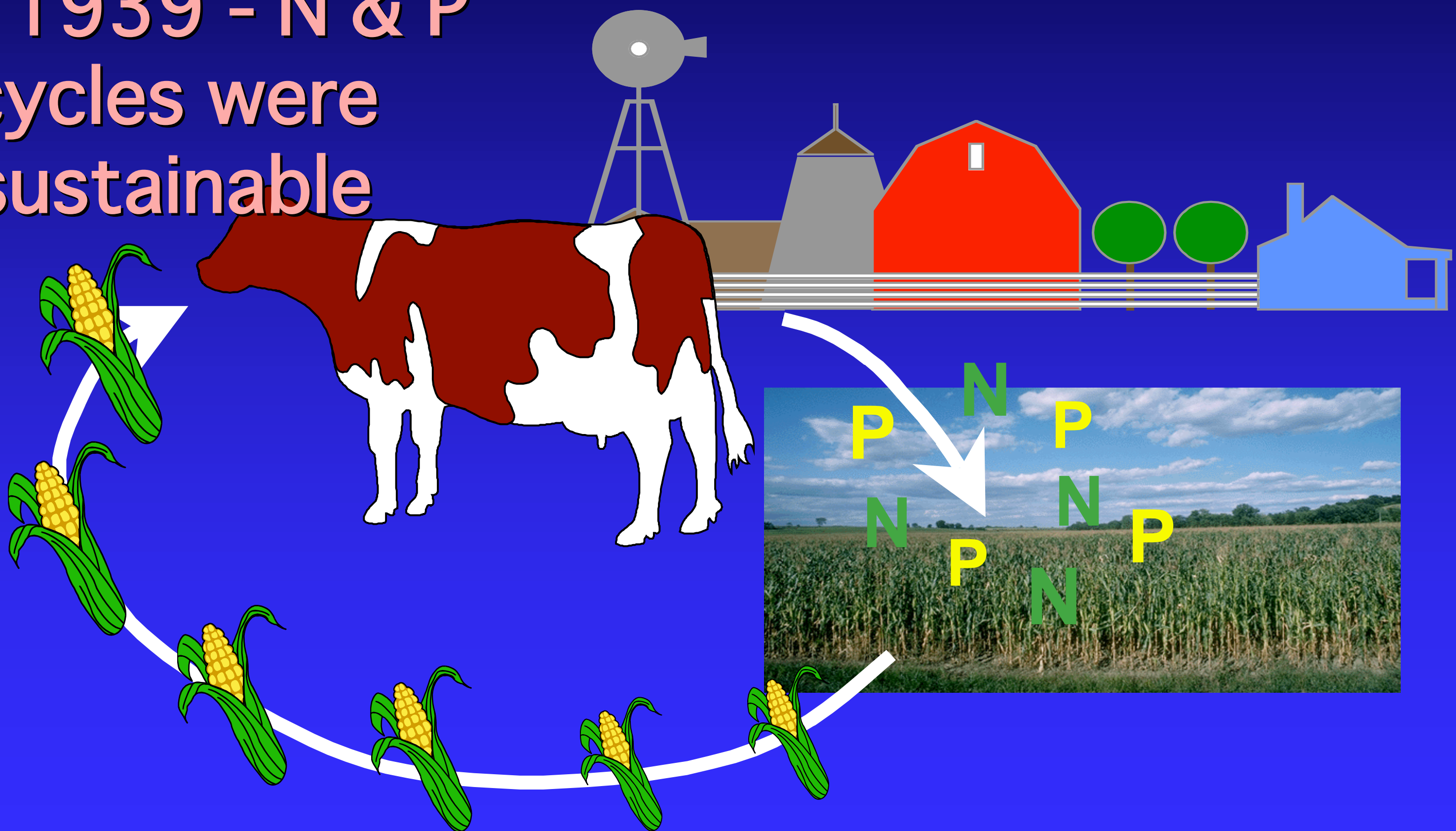


New York City Watersheds

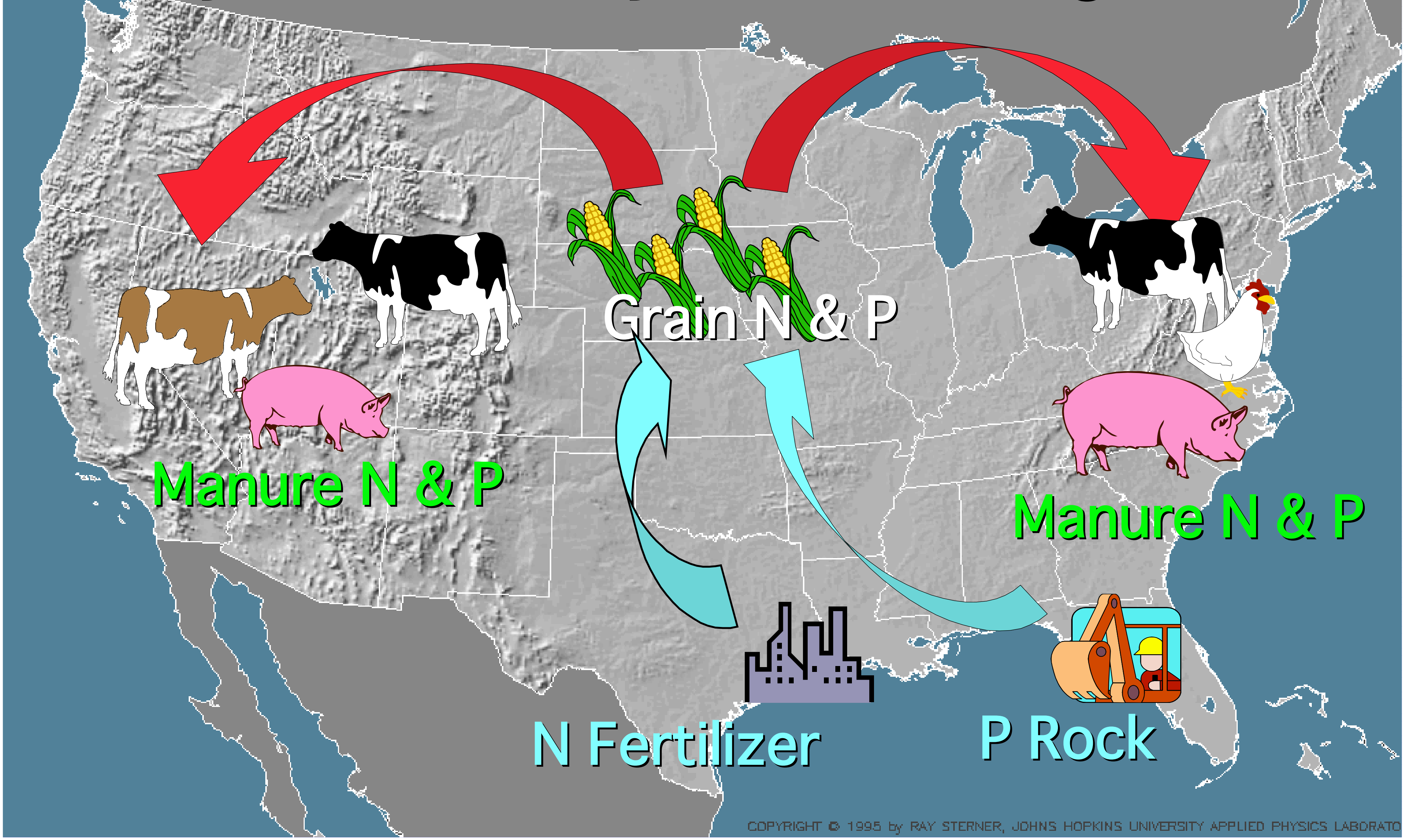
Chesapeake Bay Watershed

The Good Old Days !

Pre 1939 - N & P cycles were sustainable



Today’s N & P Cycles are Fragmented



N-Based Manure Management results in excess P application

N-Based Manure Management

P added in manure exceeds crop removal

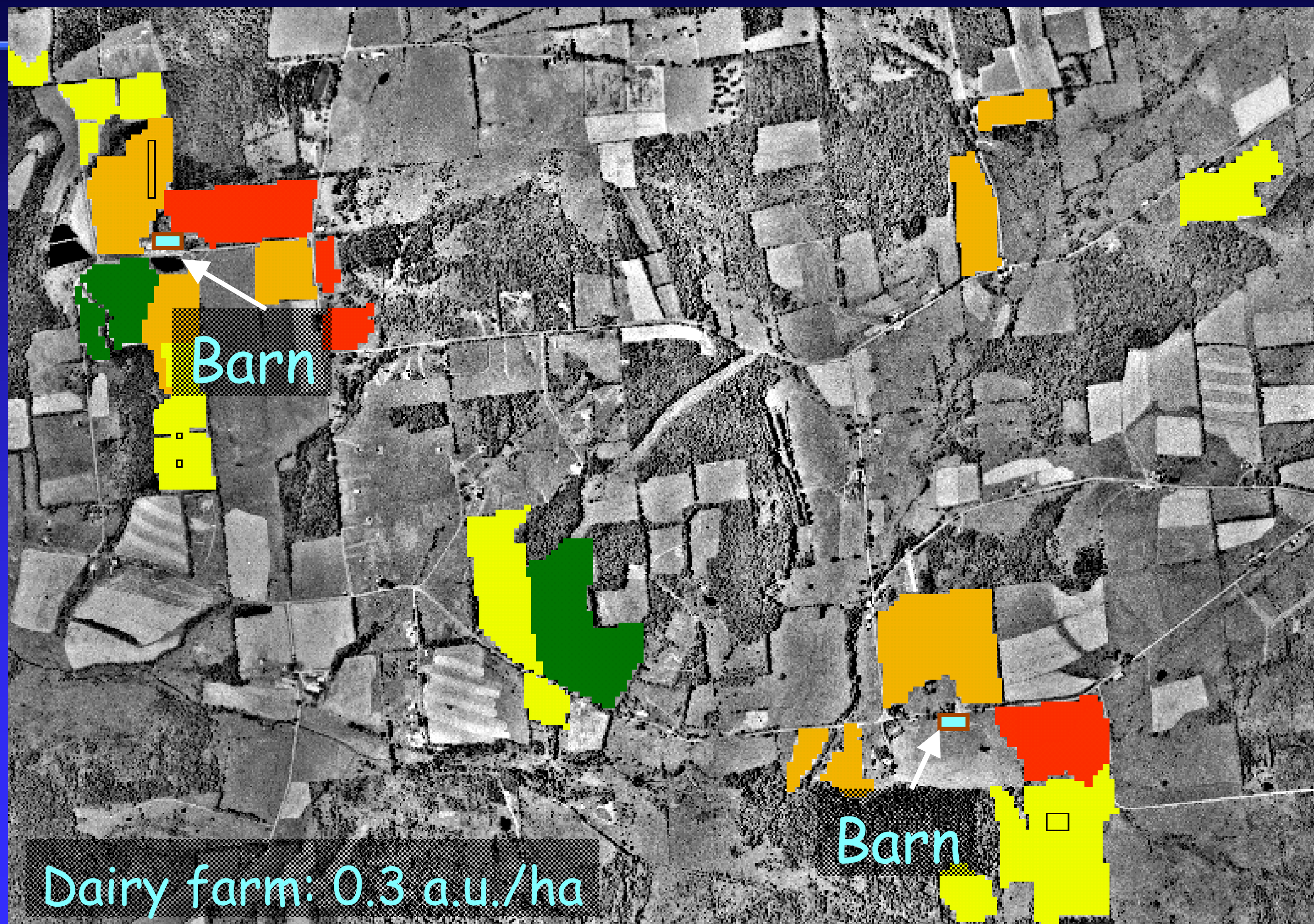
Farming System and P Balance

	Crop	Dairy	Pig	Poultry
	- - - - - - kg P/ha/yr - - - - - -			
Input				
Fertilizer	18	11	--	--
Feed	--	30	104	1690
Output	16	12	20	515
Balance	2	29	84	1175
Pennsylvania farms	Cash crop 30 ha	65 Holsteins 40 ha	1280 hogs 30 ha	75,000 birds 12 ha

P Accumulation is Localized w/in Farms!

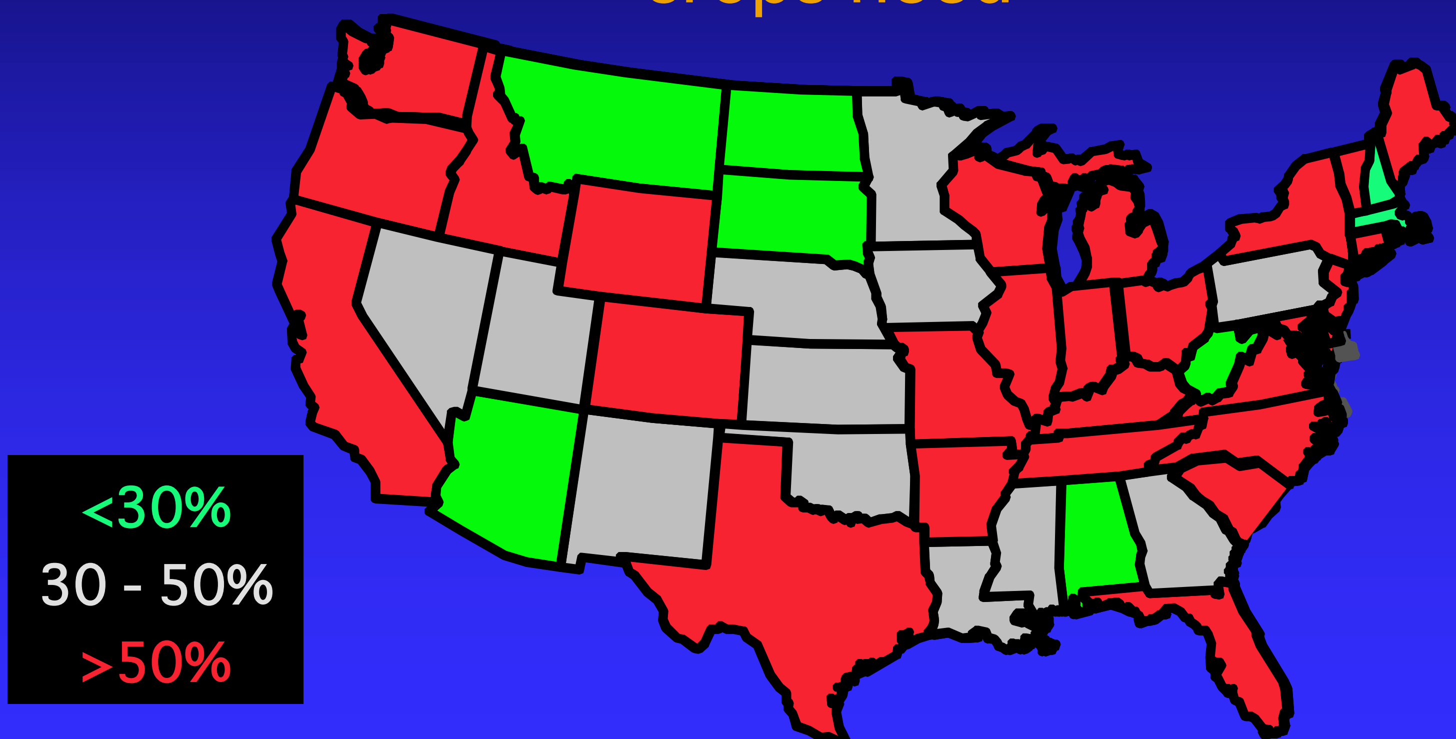
Soil P

- very low
- low
- optimum
- high
- very high

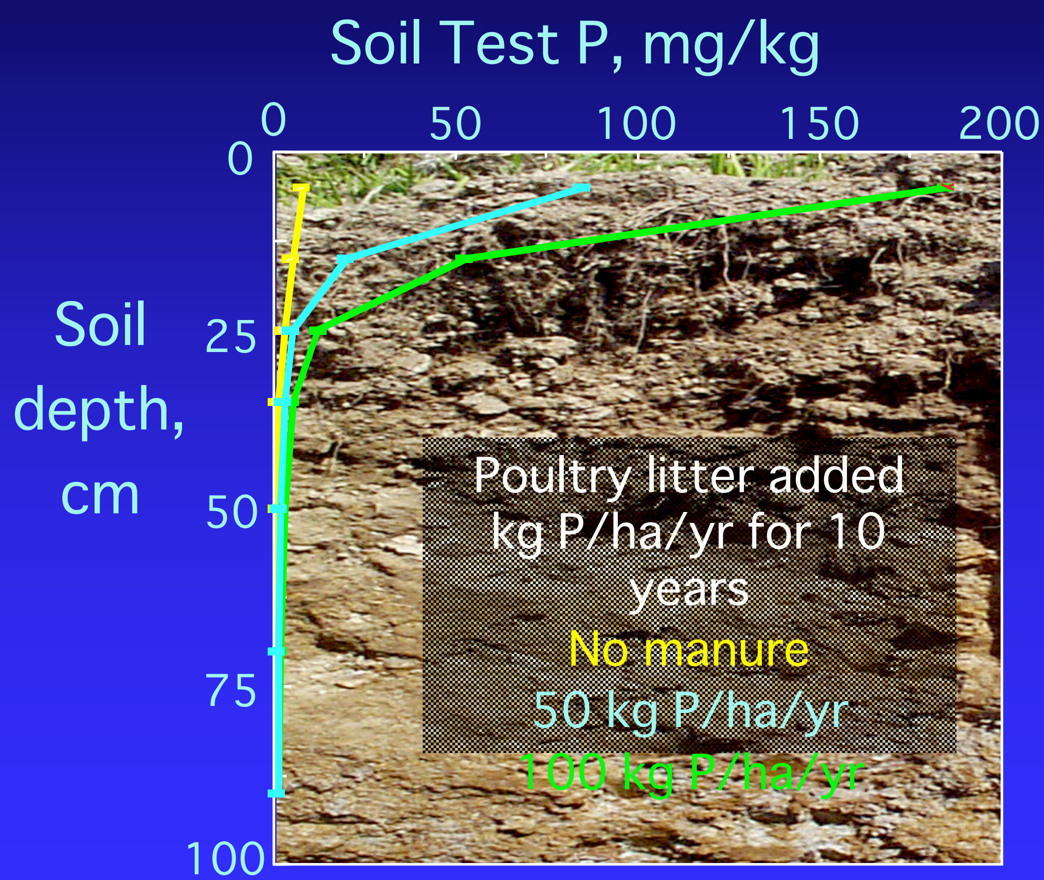


Soil Test P Survey, 1997

Percent of soils tested that had more P than crops need

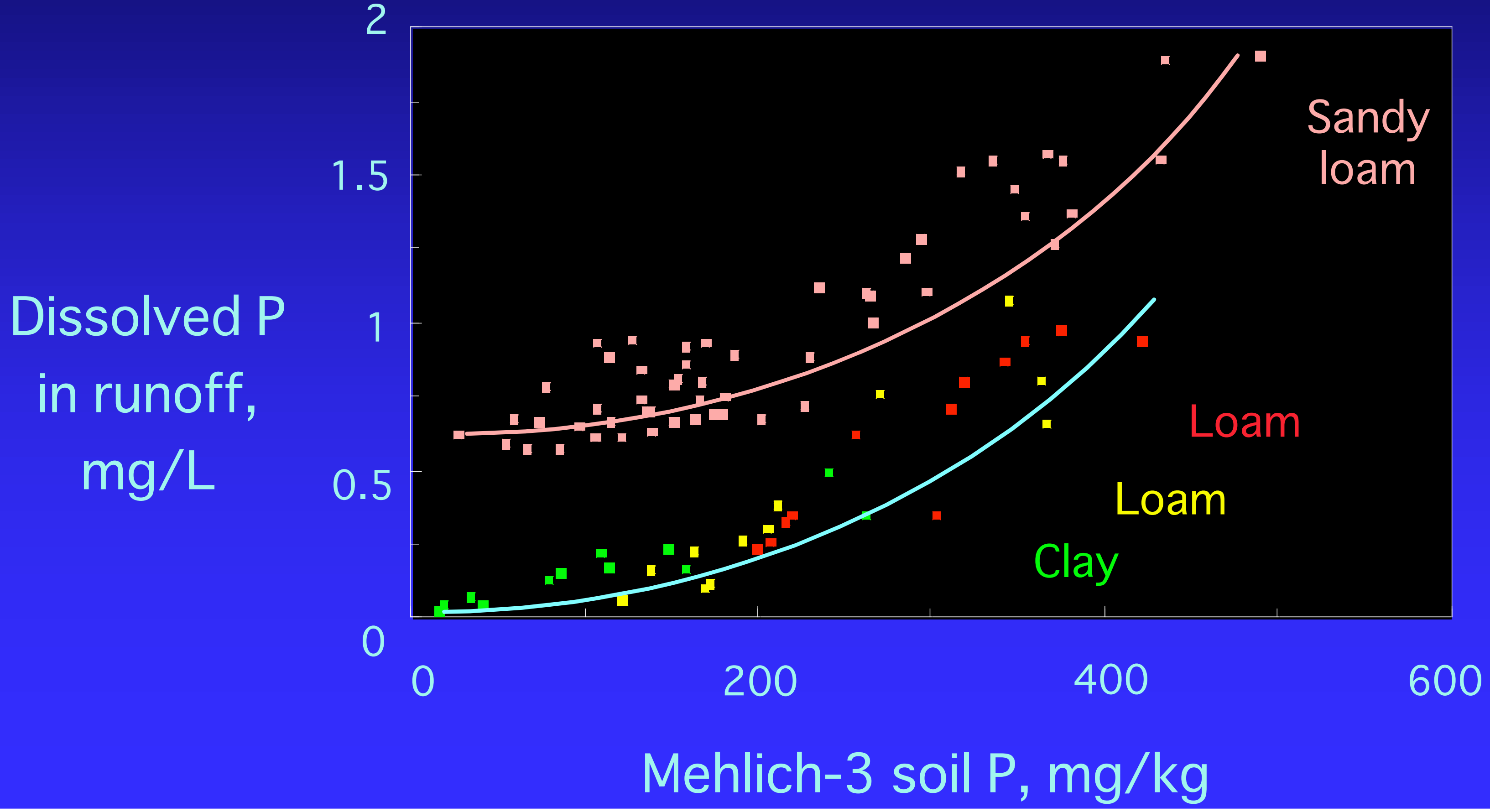


P Accumulates at Soil Surface

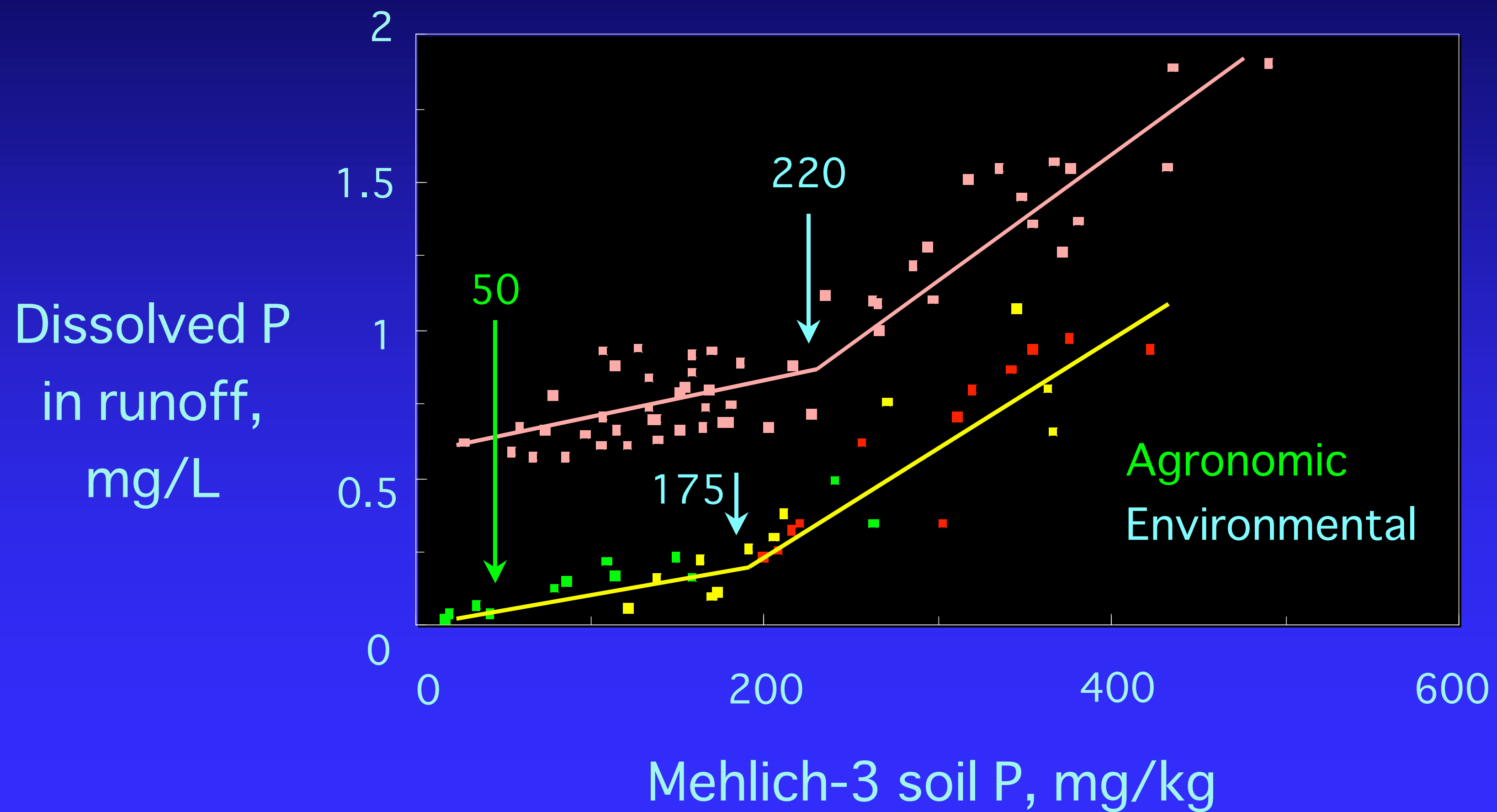


✓ This is the zone that serves as the source of P to runoff!

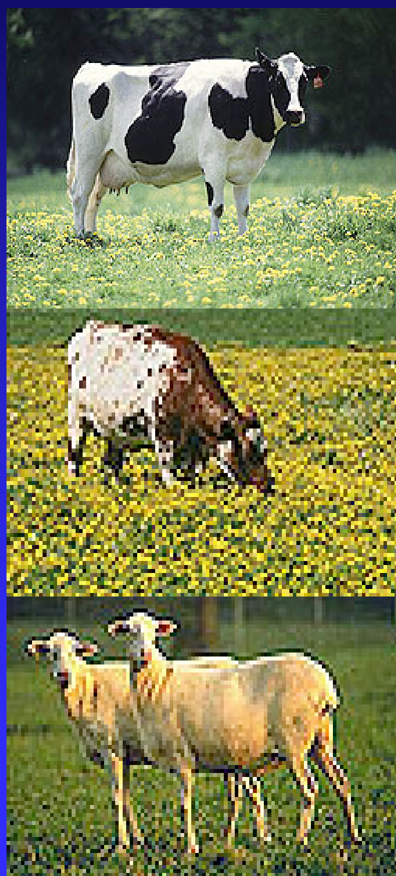
Runoff P Increases with soil P



How much is too much? Agronomic and Environmental Thresholds



Excreted Dietary P

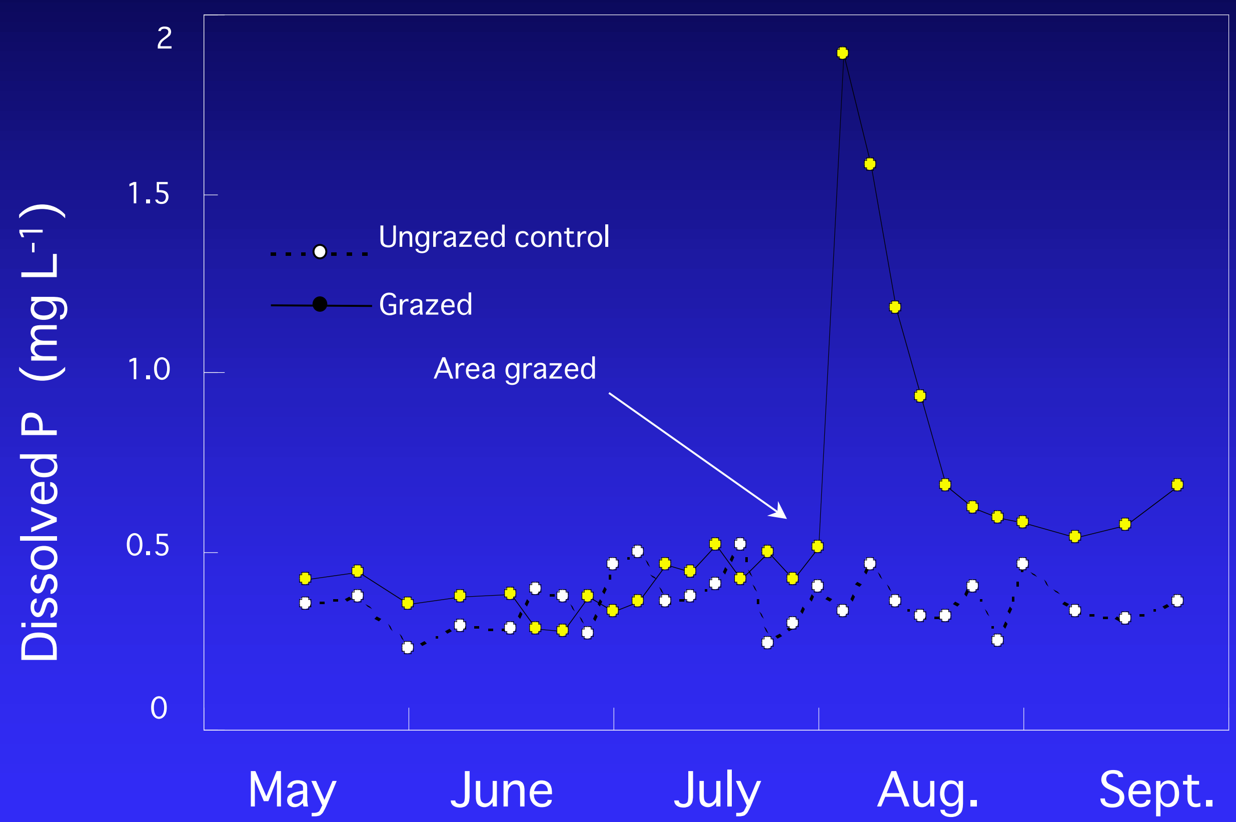


- 50-60%,~9 kg/6 months grazing
- 50-60%,~4 kg/6 months grazing
- 50-70%,~1 kg/6 months grazing

Fate of excreted P

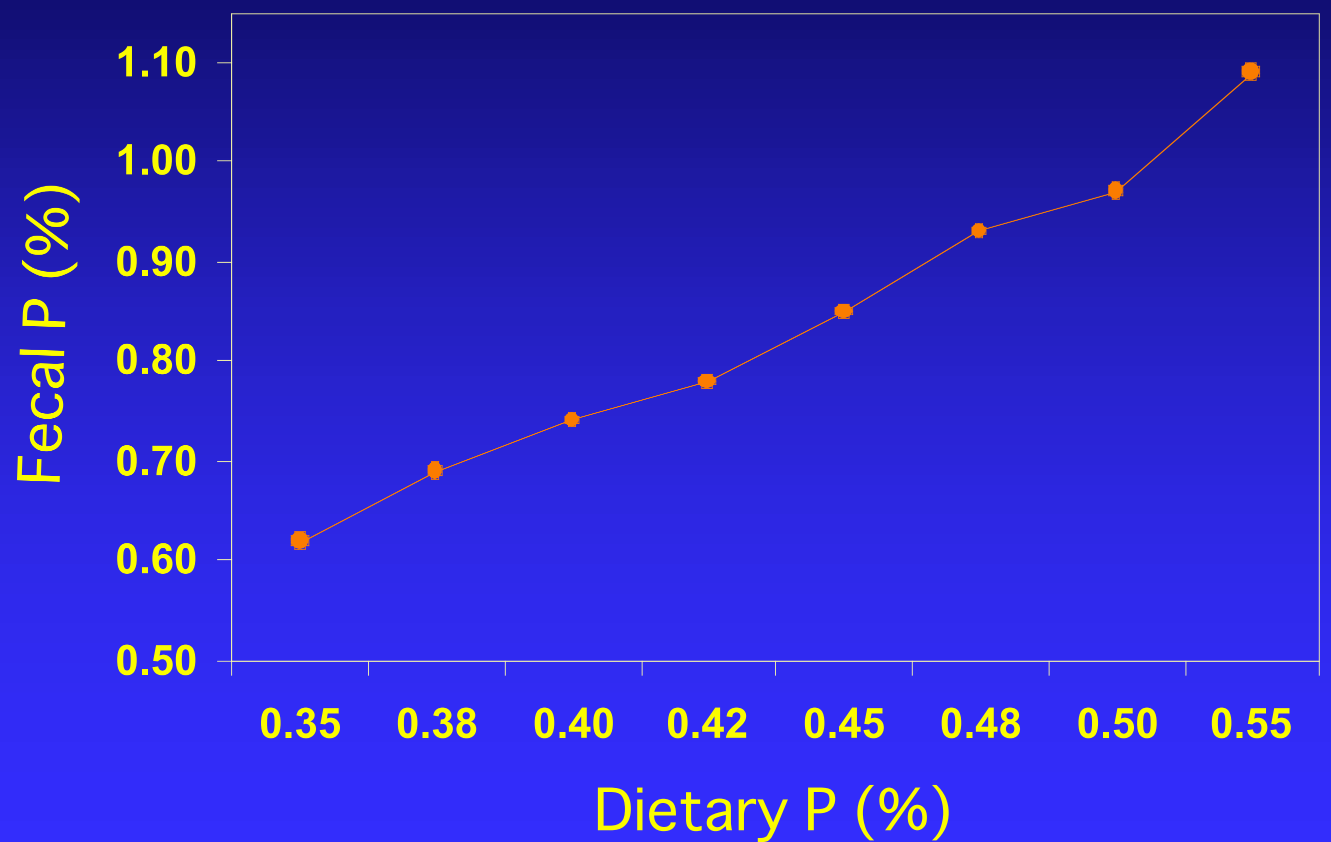
- ✓ 80% of P in inorganic form and available
- ✓ Accumulates in surface soil
  - About 5% of area
  - Most susceptible to runoff
- ✓ Accumulates in camping and feeding areas
- ✓ Surface runoff can be high
- ✓ Portion in feces increases with excess dietary P

P in Runoff



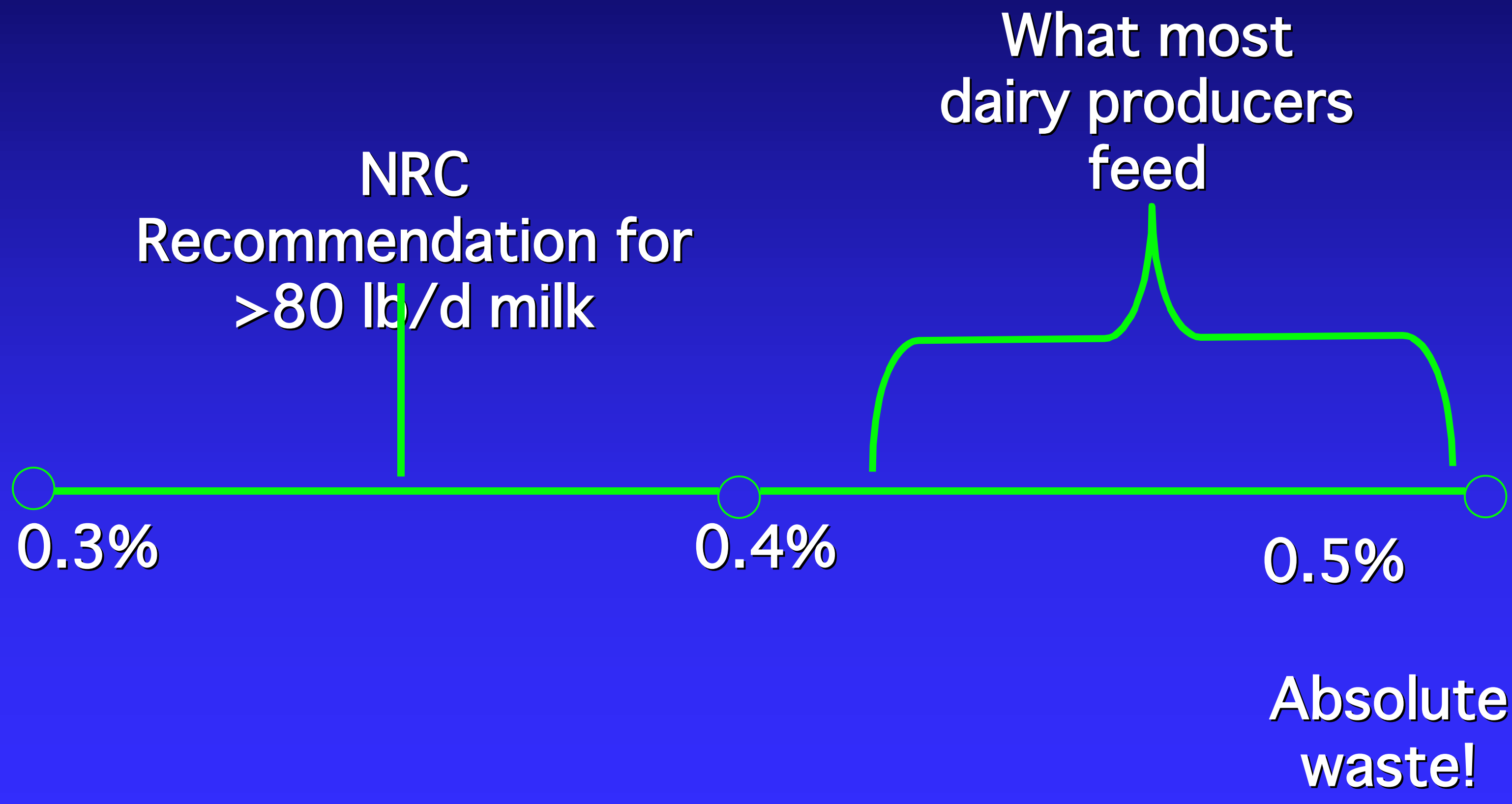
Dissolved P (mg L-1)
2
1.5
1.0
0.5
0
Ungrazed control
Grazed
Area grazed
May
June
July
Aug.
Sept.

Dietary P and Fecal P

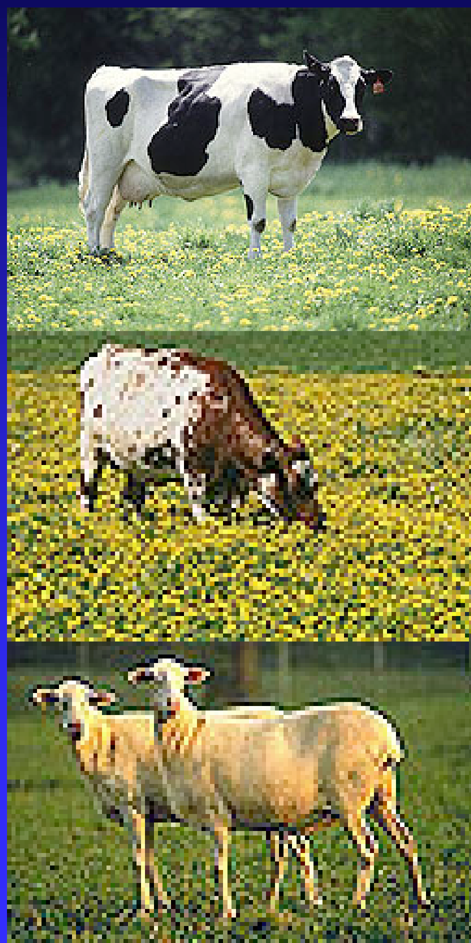


Adapted Wu, Z. and V. Ishler, 2000.

How Much Phosphorus feeding?



Excreted Dietary N



75-80%, 30-120 kg/yr.

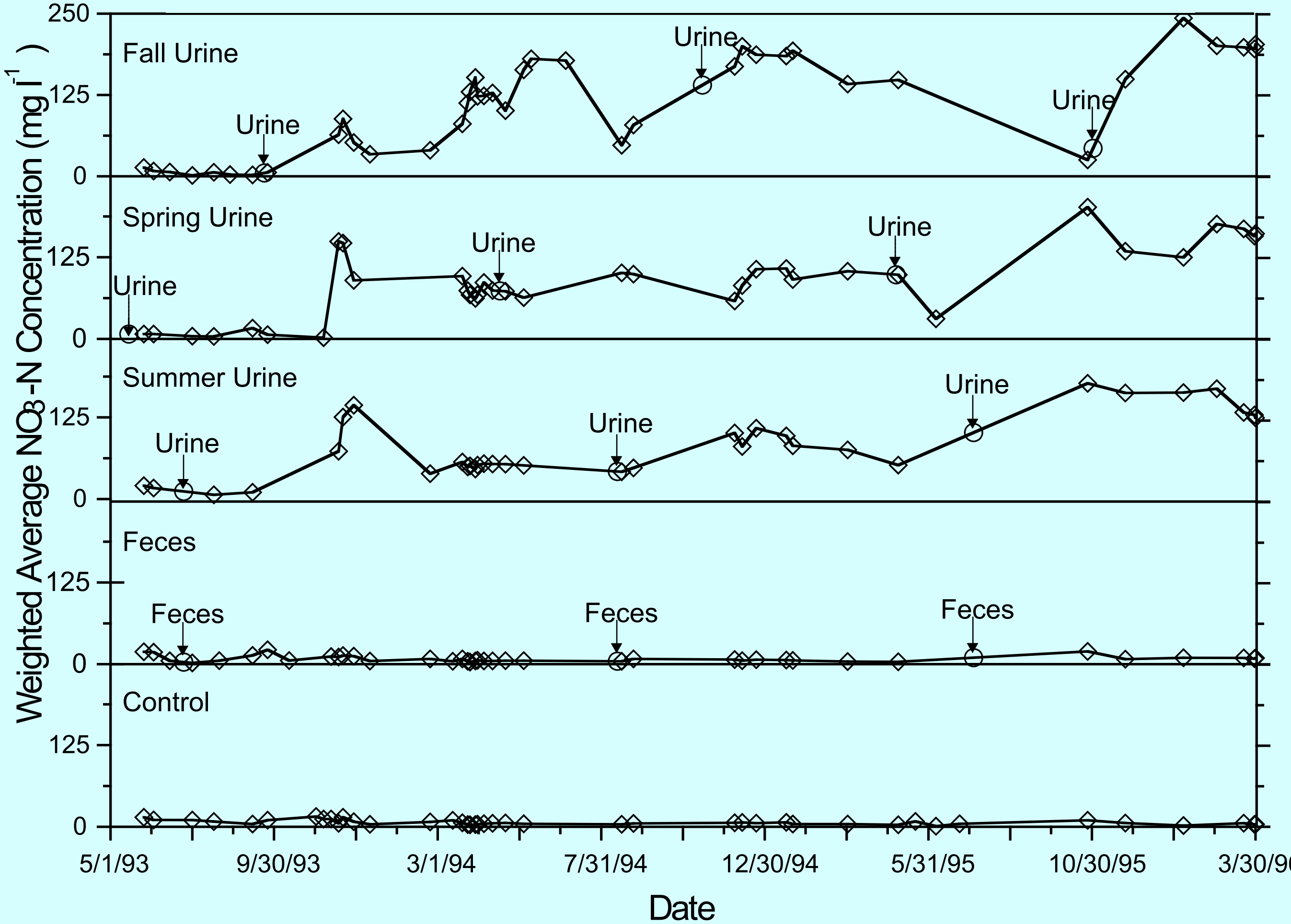
90-95%, 30-90 kg/yr.

85-95%, 5-25 kg/yr.

Excreted dietary N

- ✓ 60% in urine, 40% in feces
- ✓ But, on only about 15% of the pasture.
- ✓ 500 - 1000 kg N /ha rate under urine and fecal patches.
- ✓ ~20 % urine N leaches below root zone
- ✓ Portion in urine increases with dietary N

Nitrate in Leachate

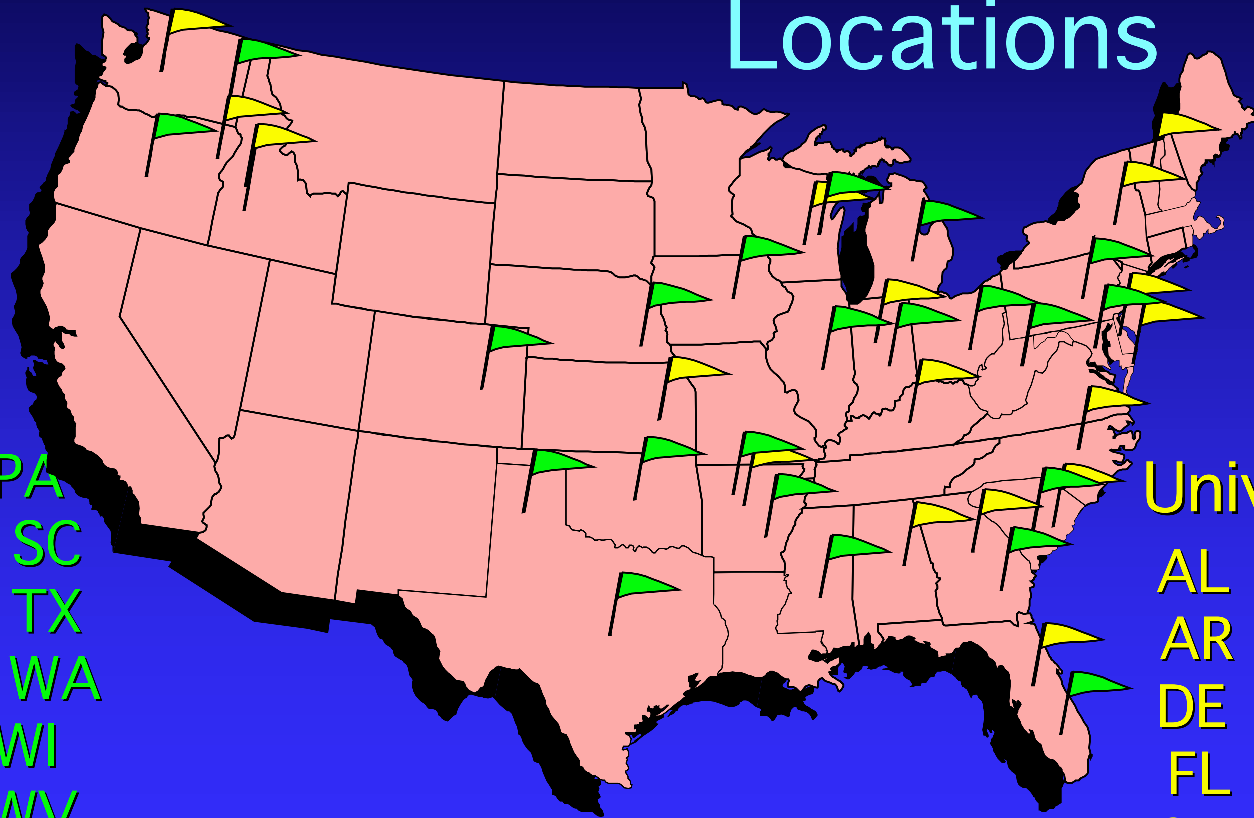


Levels of Cooperative Work

- ✓ National
- ✓ Project/Scientist level
- ✓ Multi-laboratory/institution/agency
- ✓ Mahantango Watershed

National P Research Project

Locations



ARS

AR IL PA
CO OH SC
FL OK TX
GA OR WA
IA MD WI
ID MS WV
IN NE

University

AL KS VA
AR MD VT
DE NC WA
FL NY WI
GA OR WV
IN TN

National P Research Project

Objectives

- ✓ Standardize field and analytical methods
- ✓ Define relationship between soil and runoff P
- ✓ Incorporate results into
  - Risk assessment indices and models
  - Nutrient management planning process

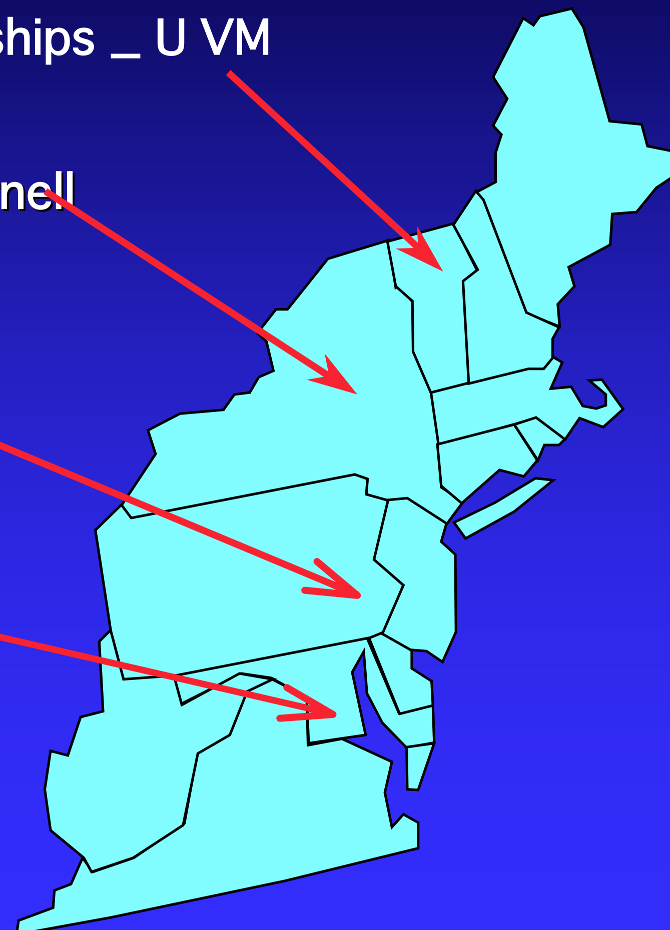
Project/scientist level cooperation

Soil P-runoff P relationships _ U VM

P Index improvement _ Cornell

P sequestering in manures _ U of Penn

Improving transport factors of
P Index _ NRCS-DC



Multi-laboratory/institution/agency cooperation

New York City water supply _ coop with Cornell, USGS, and NYC DEP; reduce P loss from dairy land use under Catskill conditions;

Cove Mt. Farm _ coop with Grazing and IFS CRISs; ARS/BARC; N leaching from pastures in grazing setting; field-scale verification of N Index; P and pathogen loss

MD eastern shore _ P sequestering, surface and subsurface P transport; coop with UMES and U Del

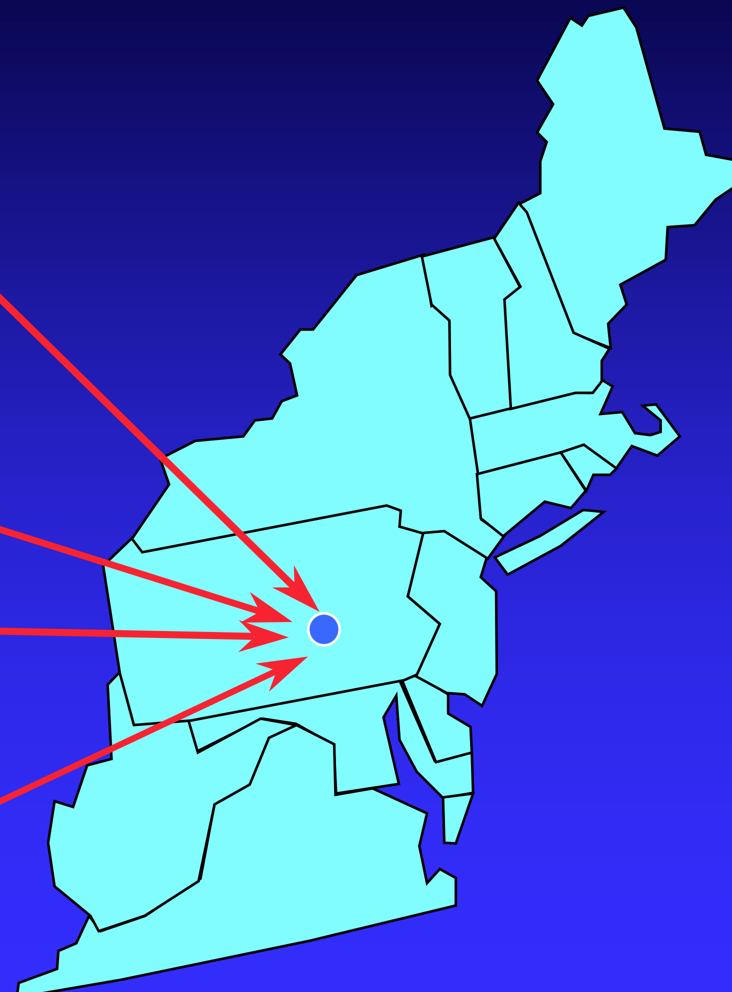
Mahantango Watershed Projects

FD-36 _ soil P-runoff P relationships at watershed scale

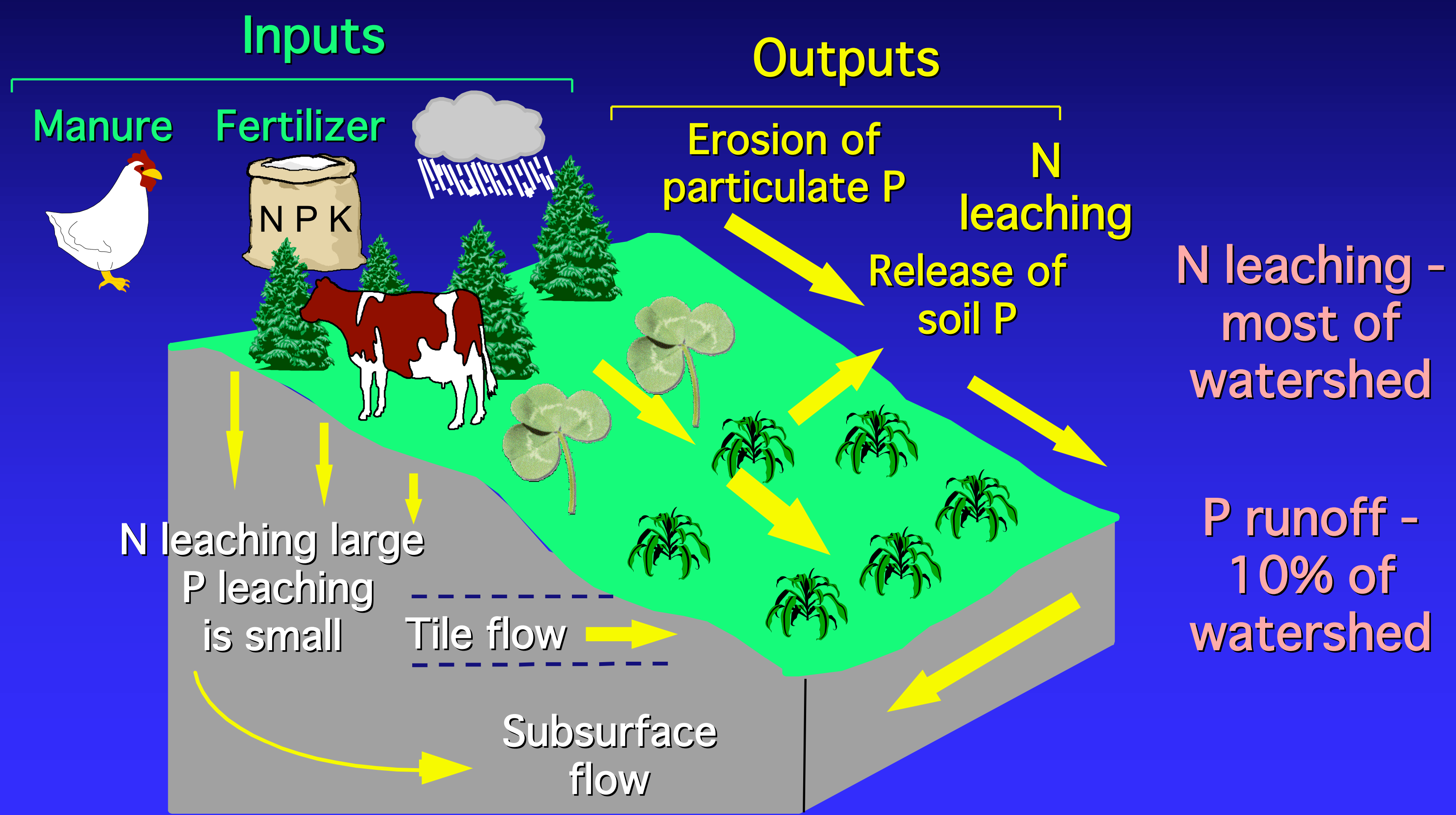
Brown Watershed _ runoff generation processes

Ground water age dating _ USGS

Pathogen transport _ ARS-BARC

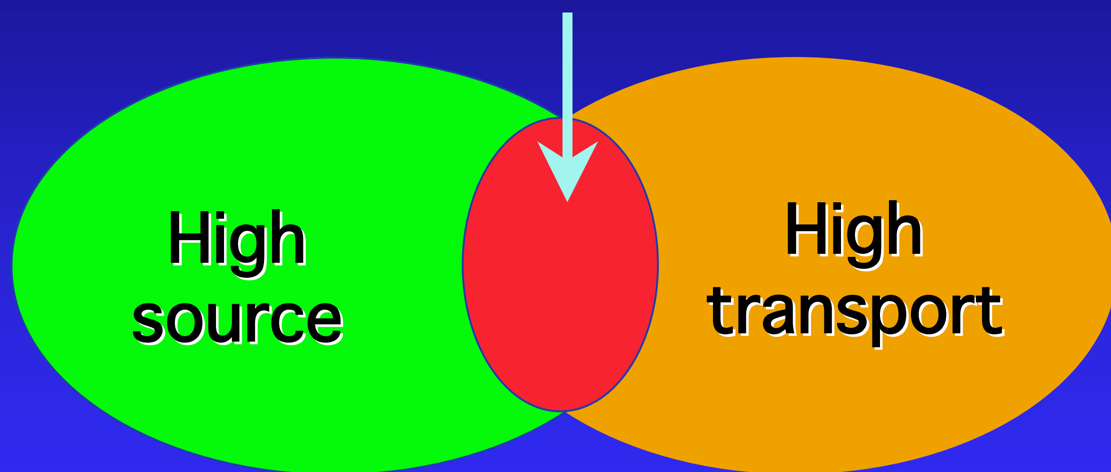


N and P Sources and Pathways



The Critical Source Area Concept

Critical source area for P and N Loss



N and P Loss Factors

N Loss

Transport

- Soil texture
- Soil permeability

Source

- Fertilizer N
- Manure N

P Loss

Transport

- Soil erosion
- Irrigation erosion
- Runoff class
- Contributing Distance

Source

- Soil test P
- Fertilizer P
- Manure P