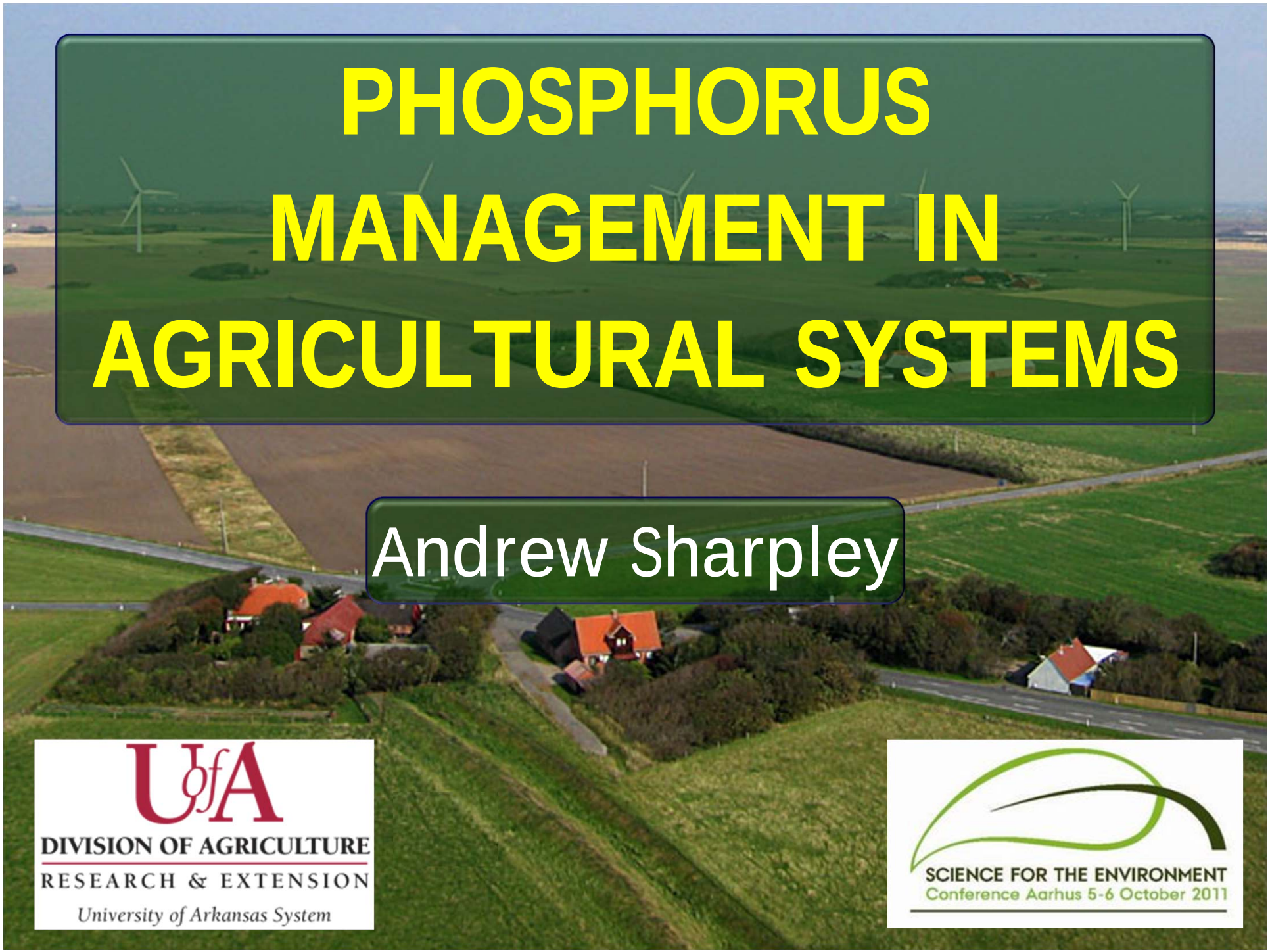

PHOSPHORUS
MANAGEMENT IN
AGRICULTURAL SYSTEMS
Andrew Sharpley
UofA
DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System
SCIENCE FOR THE ENVIRONMENT
Conference Aarhus 5-6 October 2011

Today's presentation

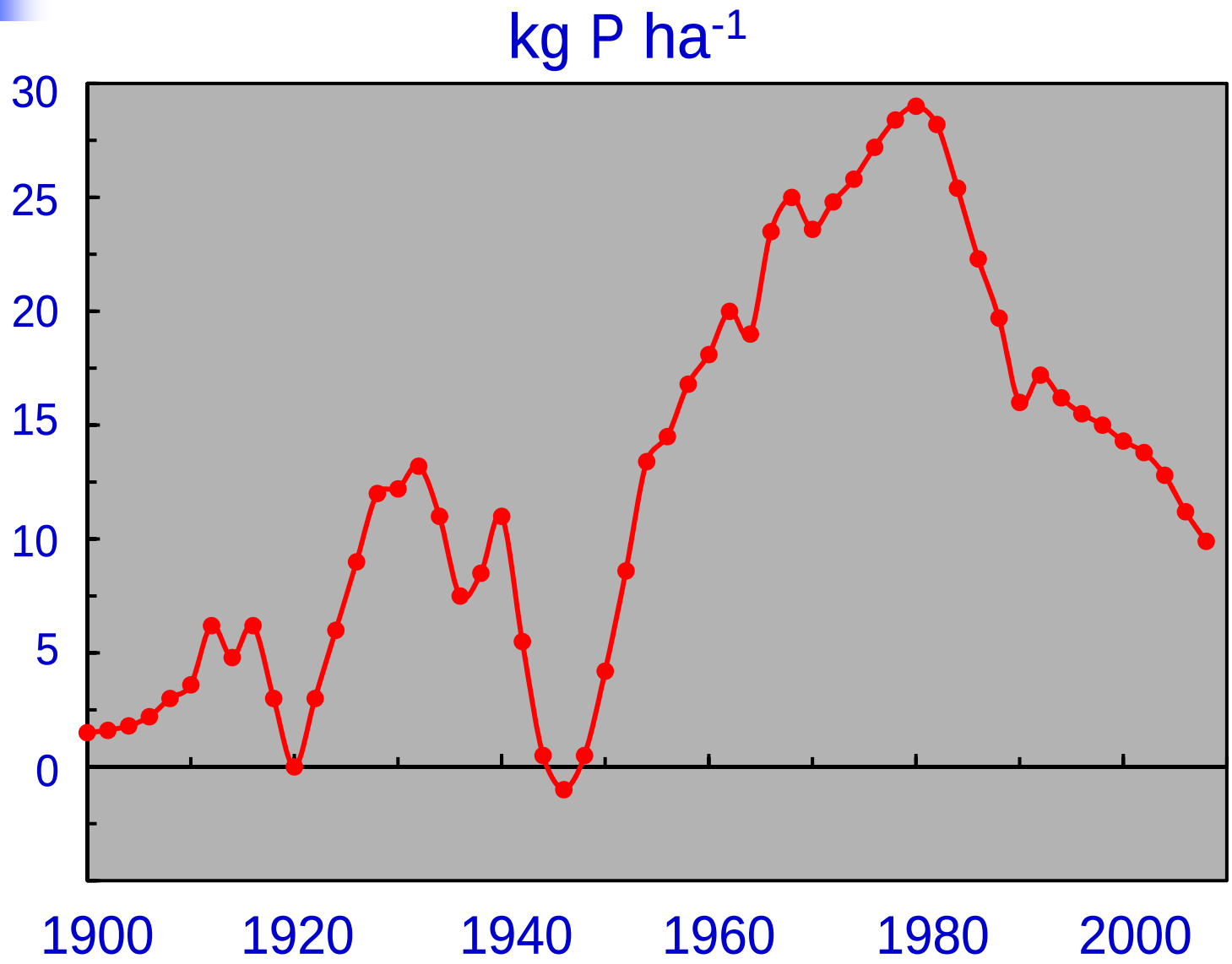
- Why are we here ?
- Targeting effective BMPs
  - Site risk assessment
  - Use of nonpoint source models
- Adapting to climate & land use changes
- Managing legacy effects
- Where do we go from here?

Cyanobacterial blooms in the Baltic Sea

MODIS AQUA 2005-07-11, data from NASA

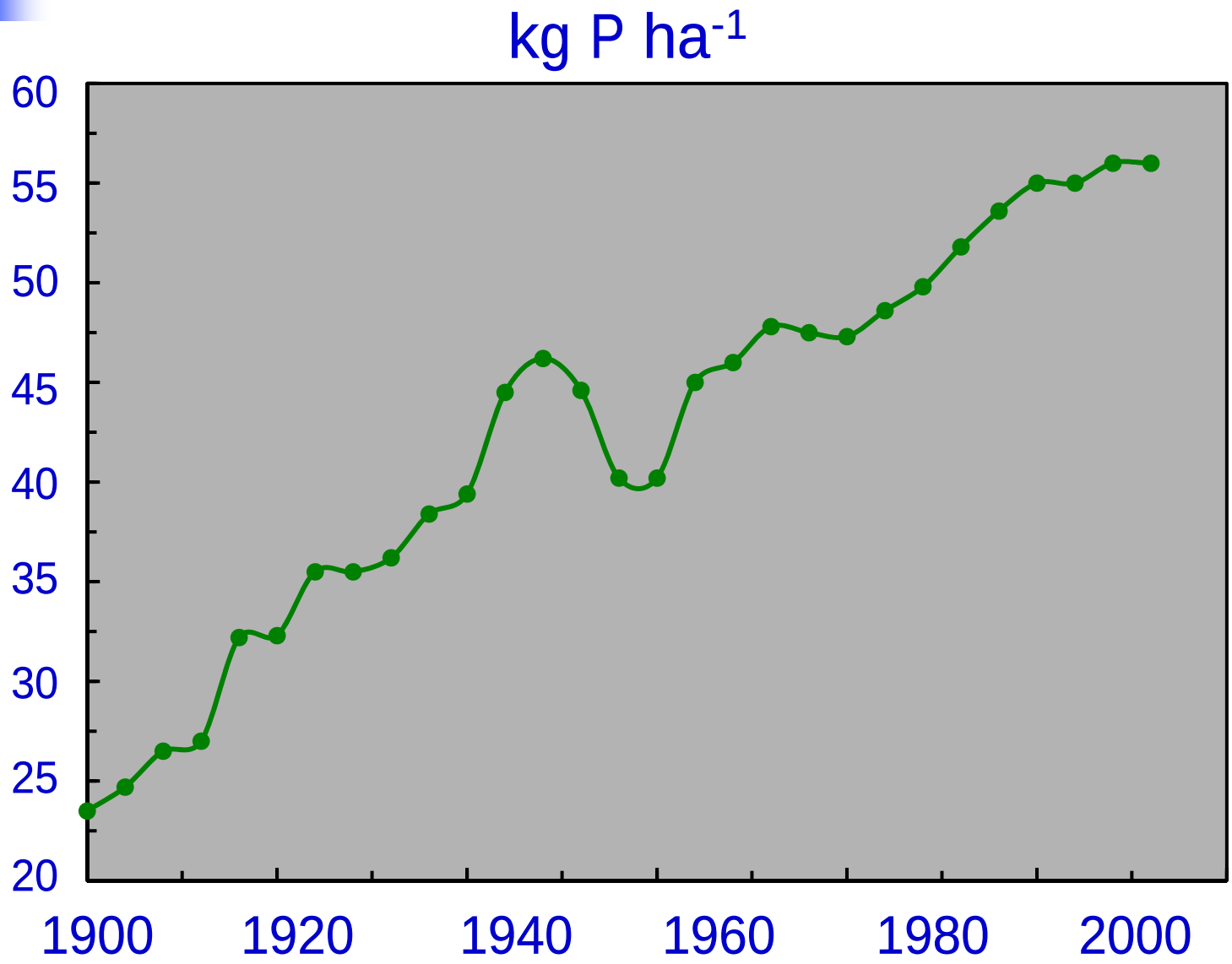
processed by SMHI

P surplus in Danish agriculture



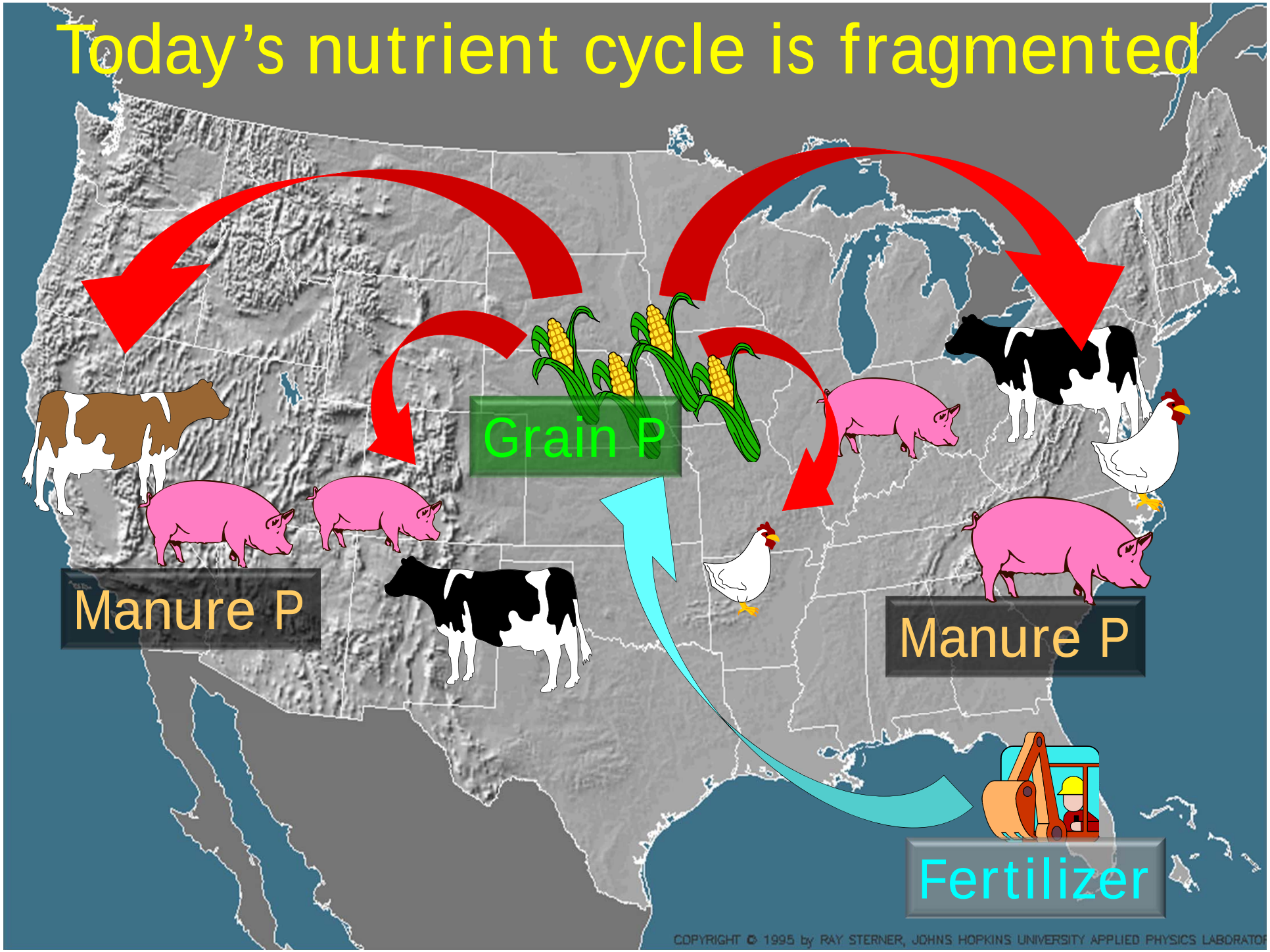
Kyllingsbaek, 2008

P utilization



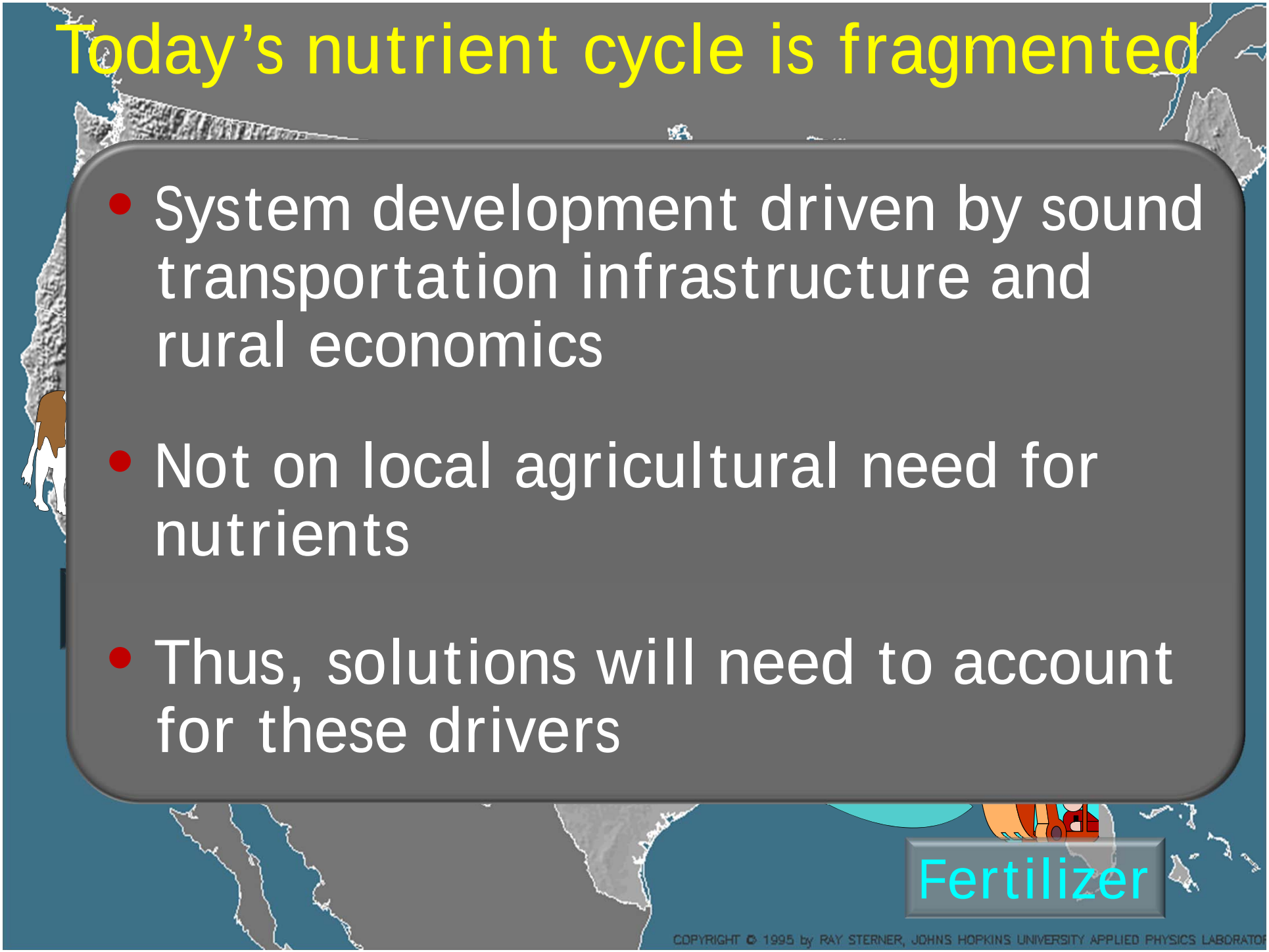
Kyllingsbaek & Hansen, 2007

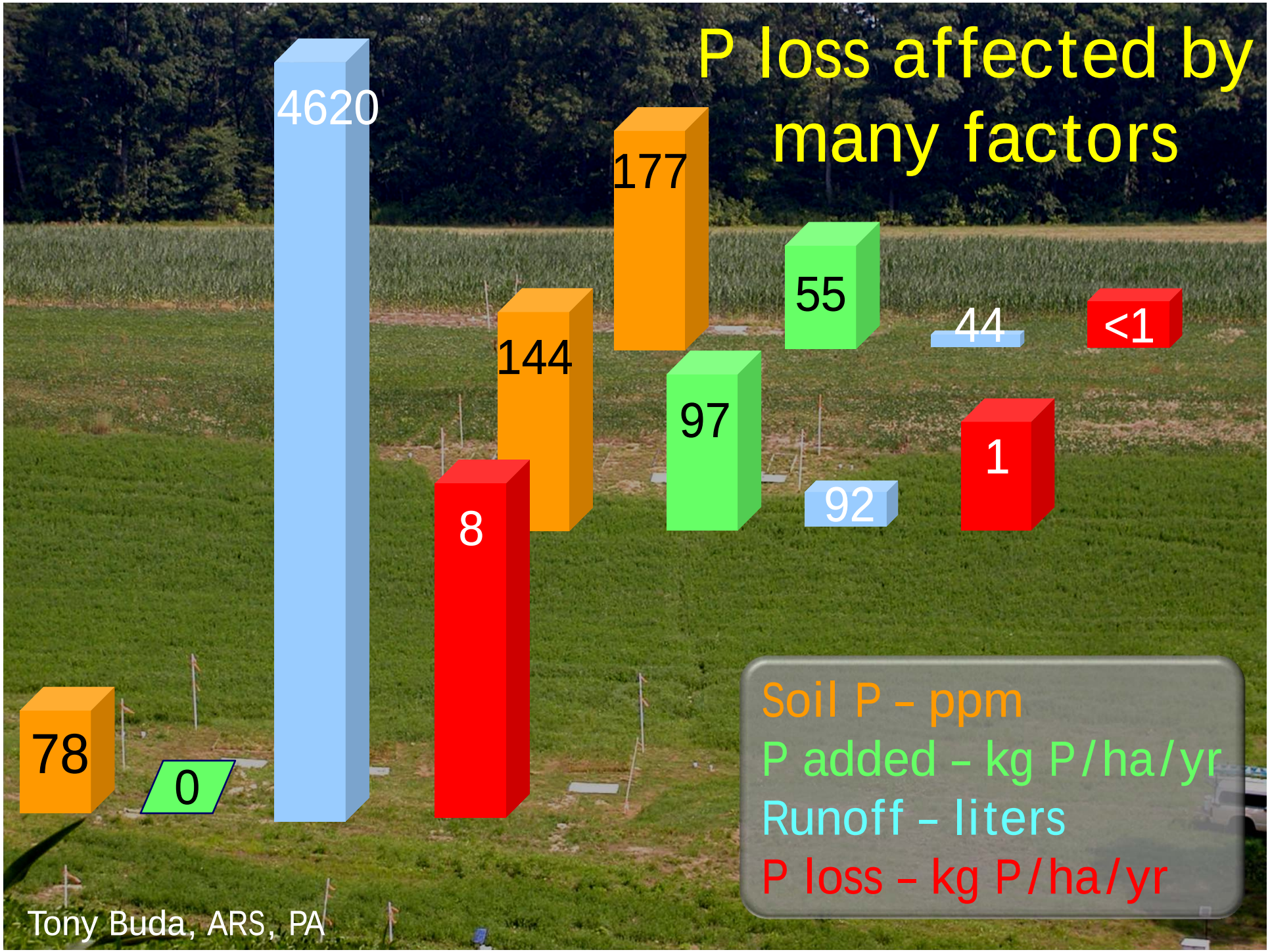
SCIENCE FOR THE ENVIRONMENT
Conference Aarhus 5-6 October 2011

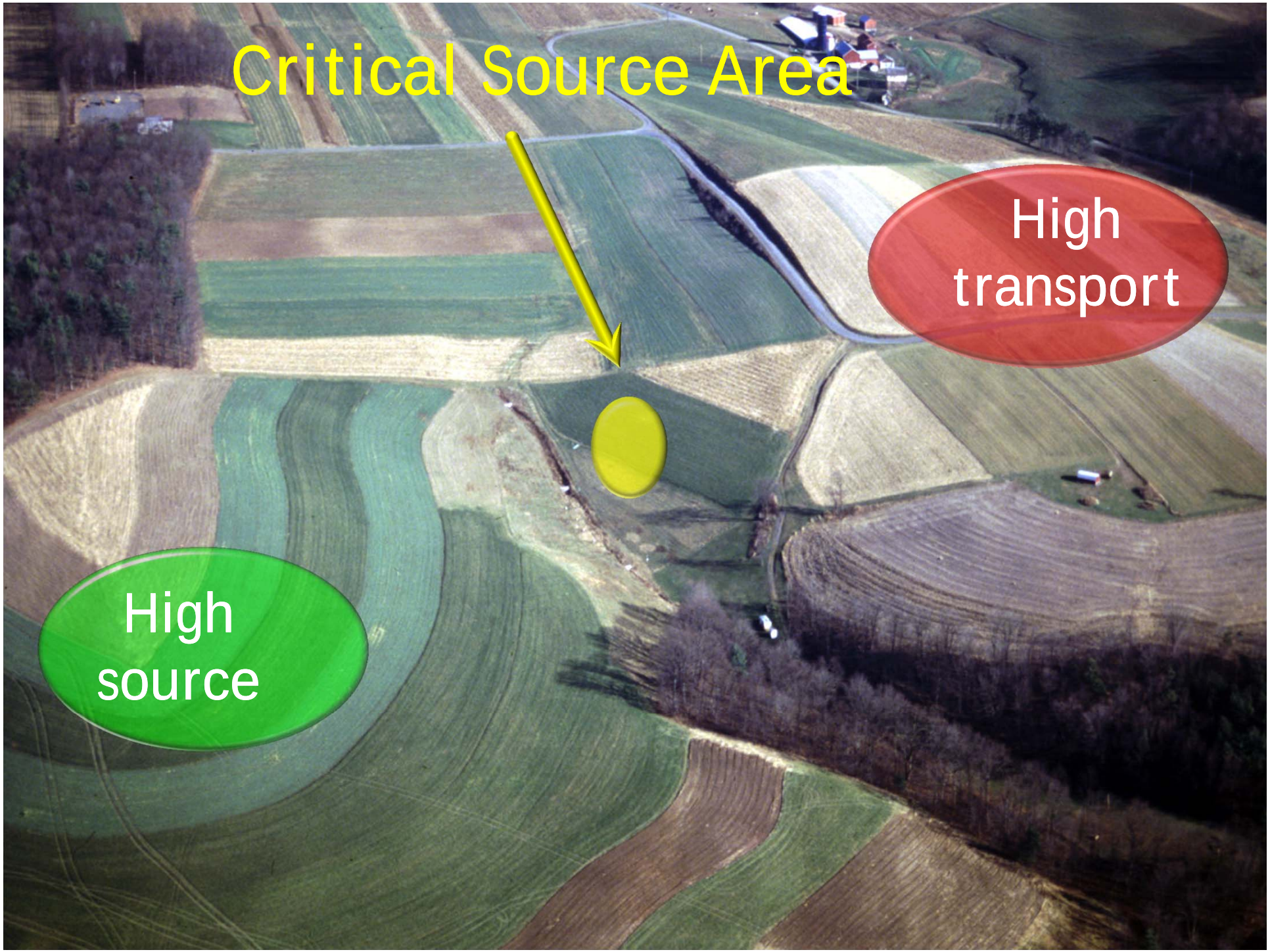

Today's nutrient cycle is fragmented
Grain P
Manure P
Manure P
Fertilizer
COPYRIGHT © 1995 by RAY STERNER, JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATOR

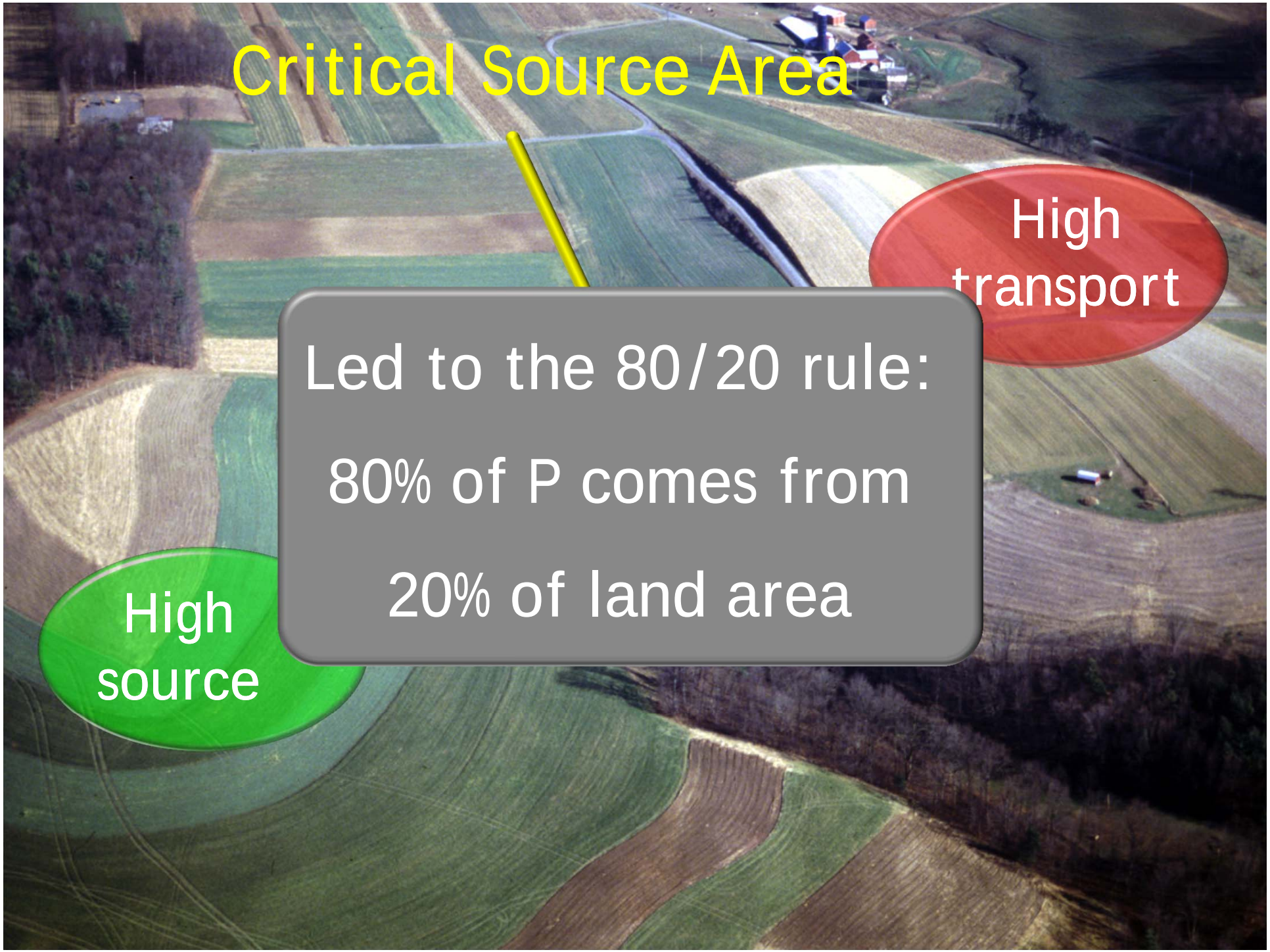
Today's nutrient cycle is fragmented

- System development driven by sound transportation infrastructure and rural economics
- Not on local agricultural need for nutrients
- Thus, solutions will need to account for these drivers




P loss affected by many factors
4620
177
55
44
<1
144
97
1
92
8
78
0
Soil P – ppm
P added – kg P/ha/yr
Runoff – liters
P loss – kg P/ha/yr
Tony Buda, ARS, PA

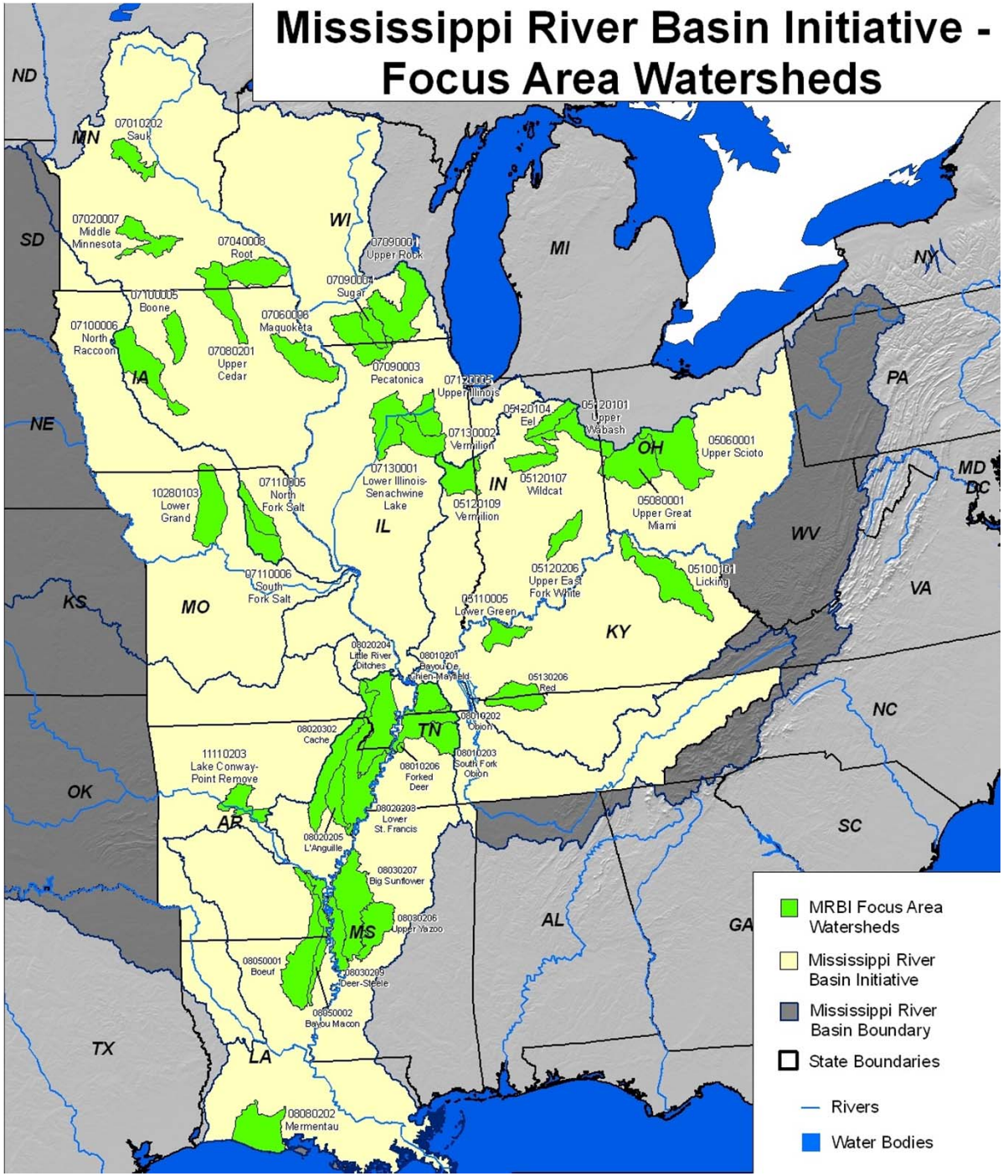

Critical Source Area
High transport
High source


Critical Source Area
High transport
Led to the 80/20 rule:
80% of P comes from
20% of land area
High source

Use of models

- Models inform decisions & targeting
  - Best way to prioritize finite resource allocation; e.g., NRCS Mississippi River Basin Initiative
- Use in numeric nutrient criteria & directives development
  - Chesapeake Bay Model, Florida waters
- Models are a representation of reality

Mississippi River Basin Initiative - Focus Area Watersheds



NRCS

SCIENCE FOR THE ENVIRONMENT
Conference Aarhus 5-6 October 2011

Input discrepancies

	EPA	USDA	Diff.
	million acres		%
Land area	41.1	42.5	3
Agricultural land	9.0	12.1	35
Cropped	3.3	4.4	33
Conventional till	1.7	0.4	-74
Conservation till	1.7	3.9	133

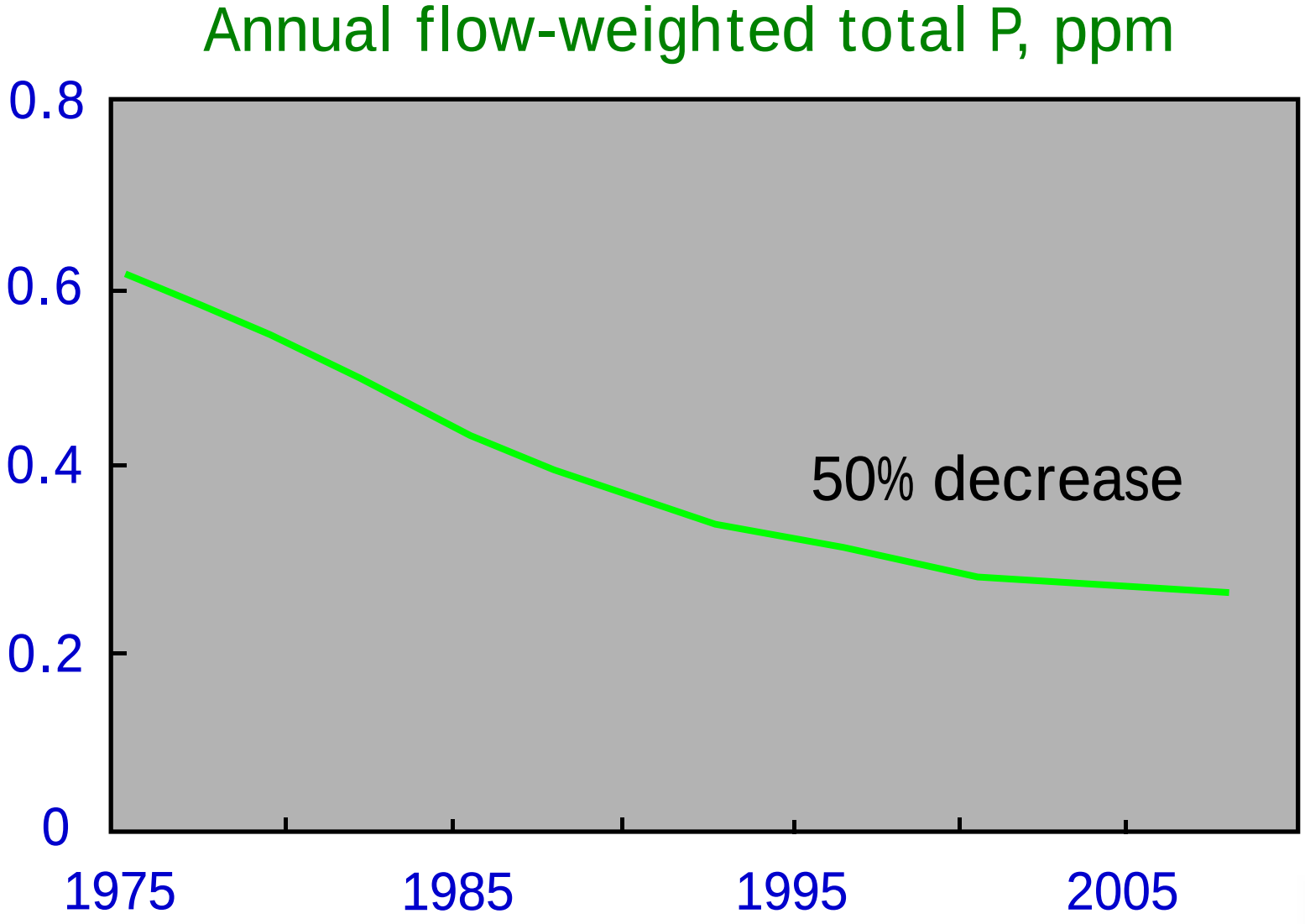
Input discrepancies

- Models have uncertainty, due to
  - Routines used; especially for hydrology
  - Input data availability
  - BMP N & P reduction efficiencies
  - Accounting for the legacy of past mgt.


Conservation tillage

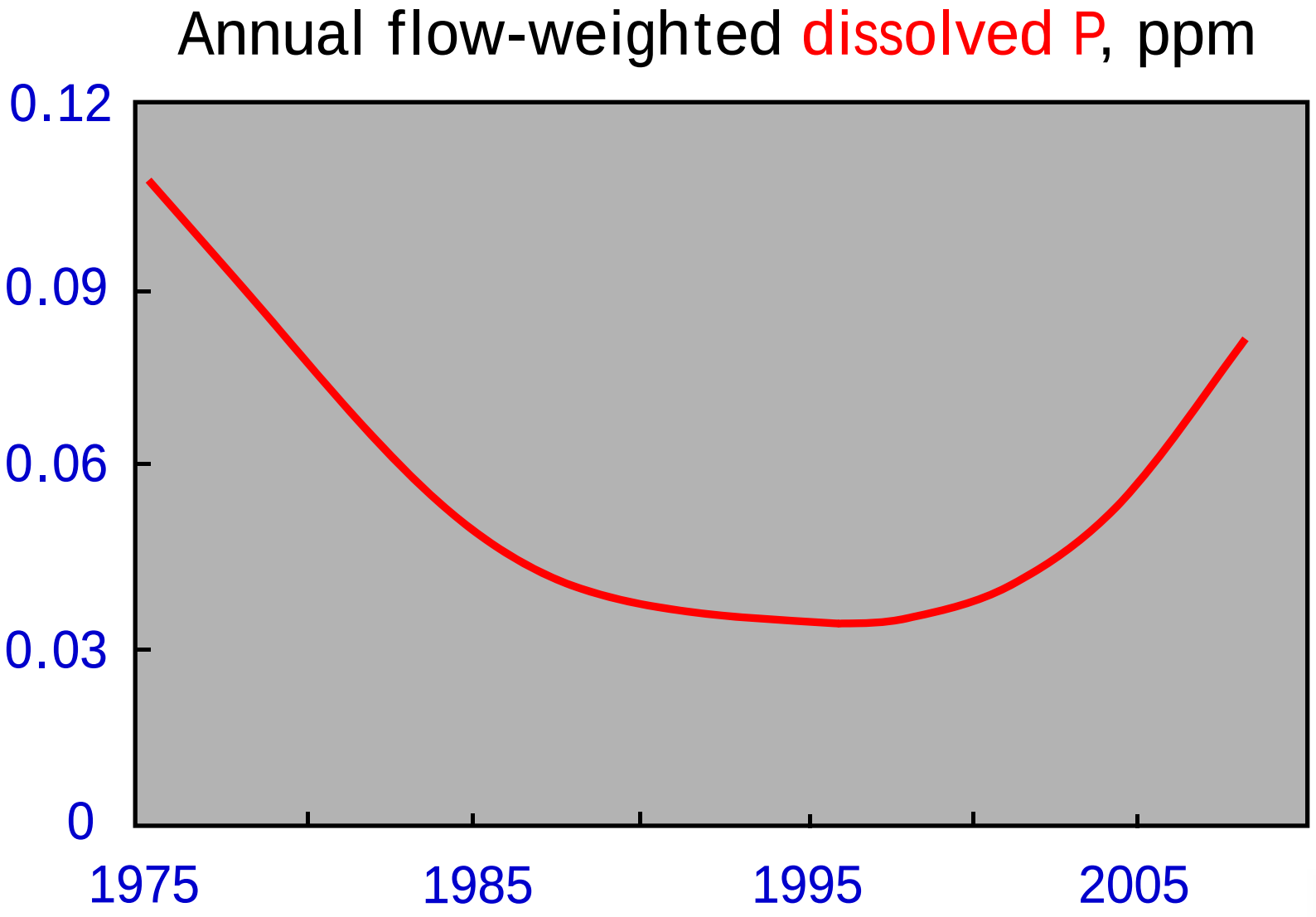

Lesson from Lake Erie Basin
MICHIGAN
Lake Erie
Sandusky River
catchment
Maumee River
catchment
OHIO

Trends in P - Maumee River



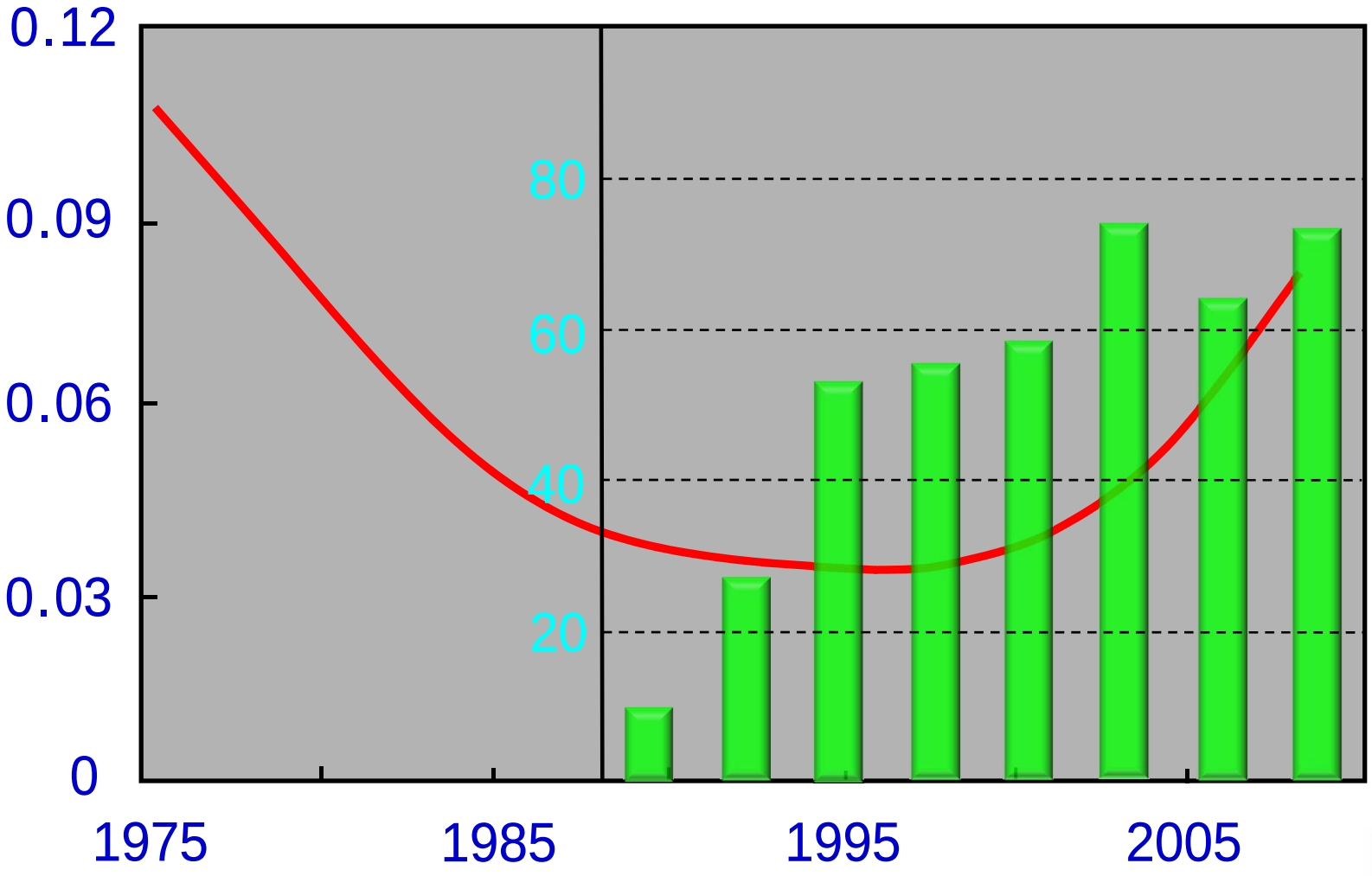
Dave Baker & Peter Richards, OH

Trends in P - Maumee River

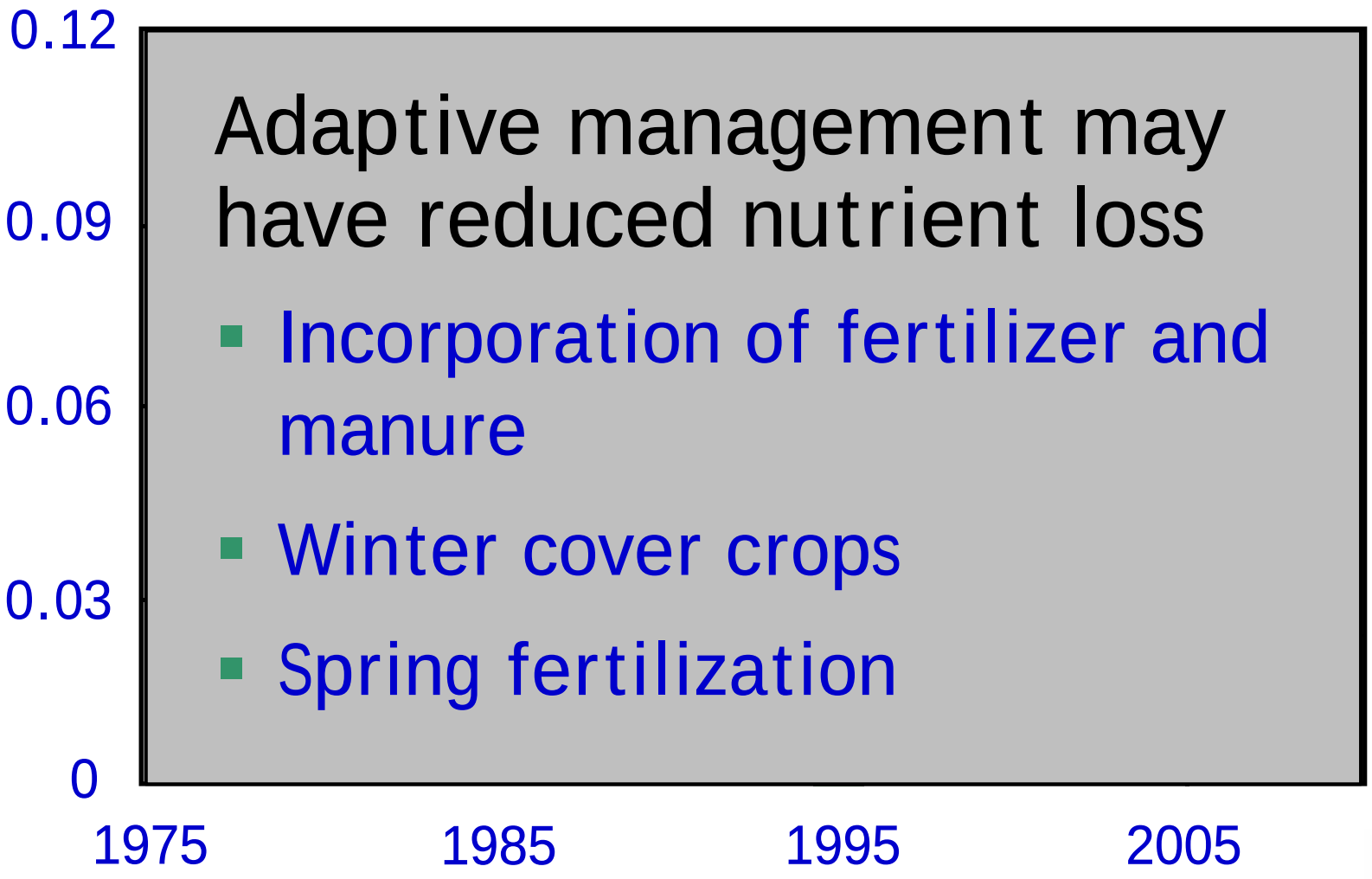


Trends in P - Maumee River

Adoption of mulch and no-till soybeans, %



Trends in P - Maumee River

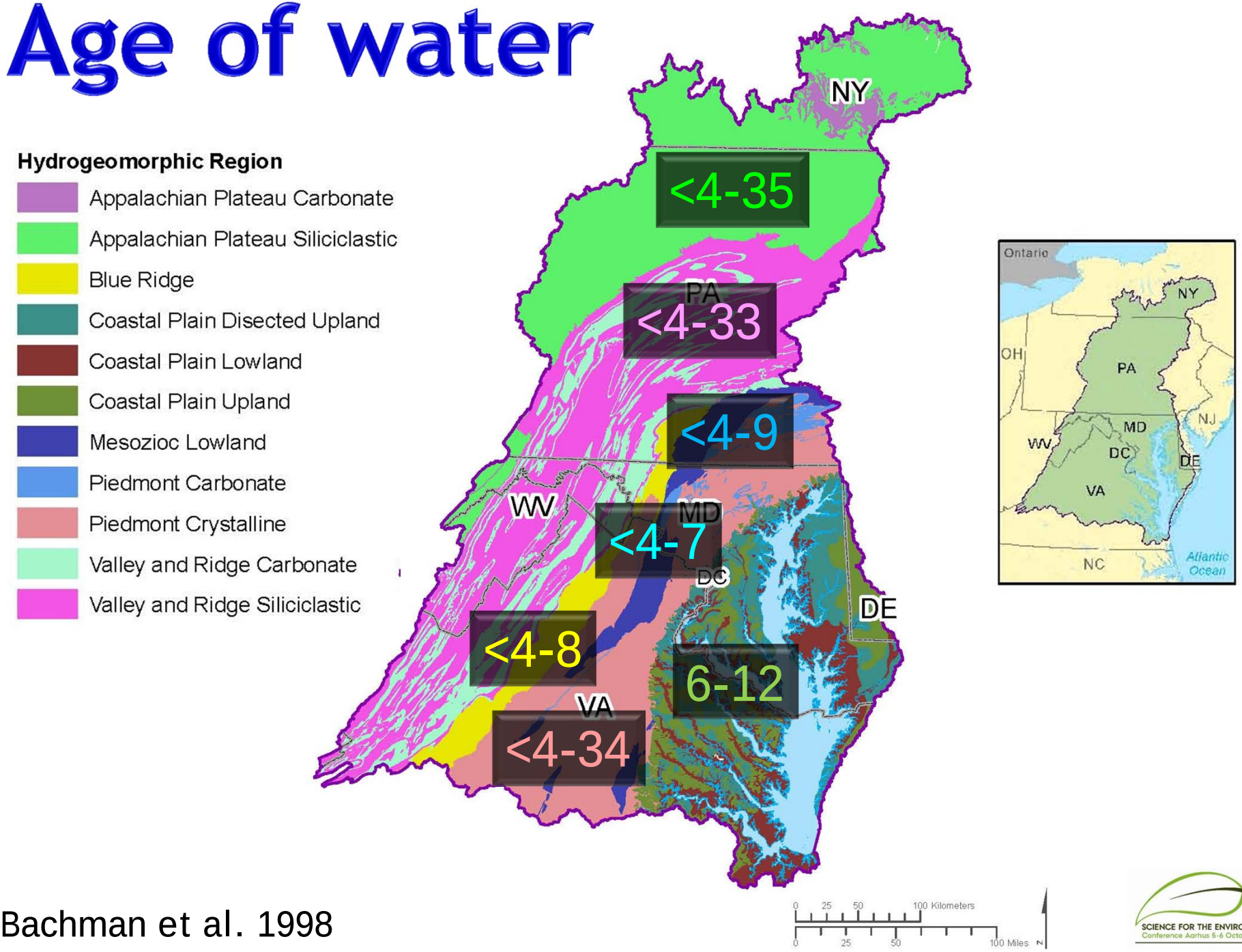


But the reality is …….

- For farmers
  - Spring workload is huge
  - Fertilizer usually costs more in spring
  - Less soil compaction on frozen ground
  - More time-sensitive tasks in spring

Legacy effects and response to watershed management change

Age of water

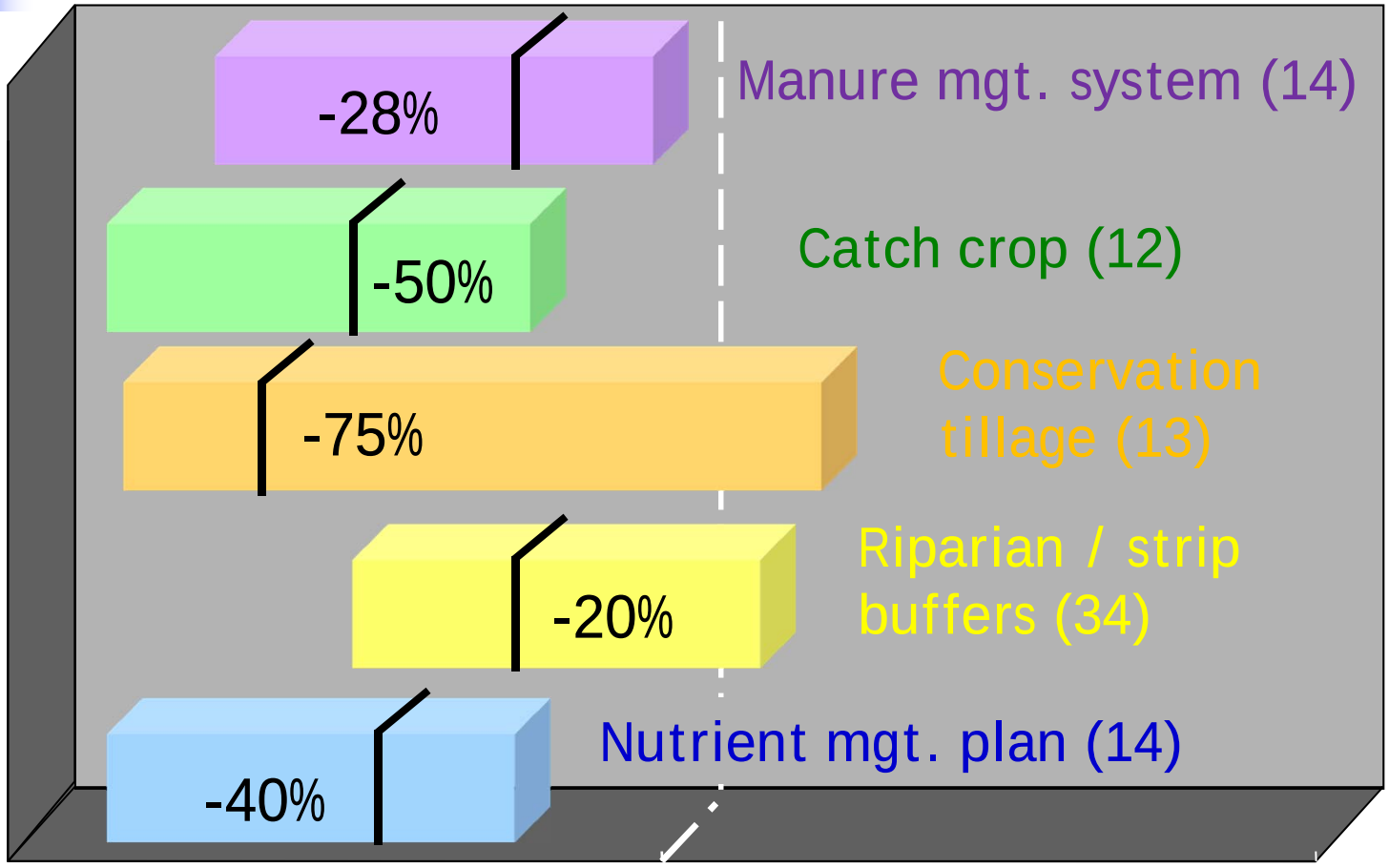


Bachman et al. 1998

System response drivers

- Nutrients
  - N - groundwater flow pathways 1 day to several decades
  - P - release from high P soils & fluvial sediments
- Sediment
  - Response more immediate – effect on light penetration
- Source complexity and lag times increase with scale

BMP effectiveness



-100 ← Decreased loss 0 Increased loss → 100

Effect on total P loss, %

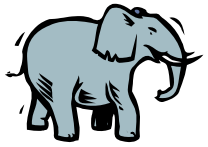
COST, 2011 & Gitau, 2005

Discovery Farms Program

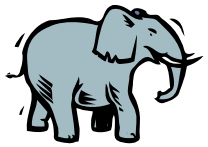
- Core farms that reflect “real-world” systems
- On-farm research and demonstration
- Address local and regional water issues
- Demonstrate success stories


One of the most important aspects is farmer involvement

The elephants



Public expects blue waters and green pastures



With predicted population growth, 50 -100% increase in crops yields on same acreage

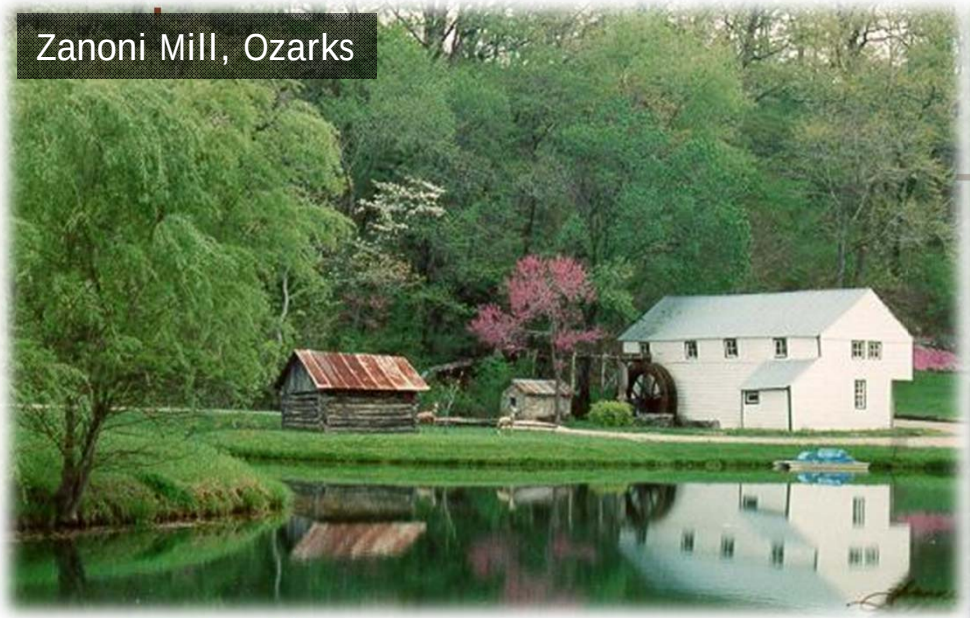
- Will create pressures to intensify
- Pressures to maximize yields
- Likely on less suitable lands
- Economics remains a major driver

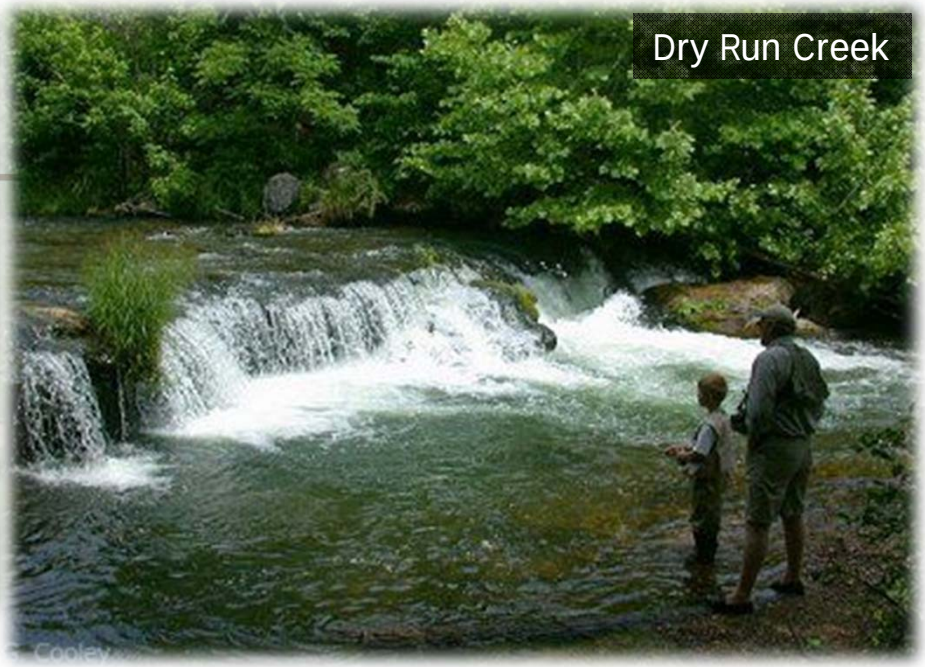
The bottom line

- Complex site hydrology turns everything on it's head
- Robust monitoring to document change
- Accounting for the legacy of past mgt.
- Explaining legacy effects
  - Reduce public disillusionment and impatience

Herding elephants

- Policy requires black & white guidelines
- Science tries to account for all variables and situations
- Realistic goal setting
- Targeted management in an equitable manner





Tak .....

SCIENCE FOR THE ENVIRONMENT
Conference Aarhus 5-6 October 2011