Western New York Crop Management
Annual Meeting
March 3, 2015
Batavia NY

IPNI
INTERNATIONAL
PLANT NUTRITION
INSTITUTE

Using 4R Nutrient Stewardship to Improve Yields and Water Quality

Tom Bruulsema, Director, Northeast Region, IPNI

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twitter.com/IPNIstewardship

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Arab Potash Company

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The Mosaic Company

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PhosAgro

PotashCorp

Qatar Fertiliser Company (QAFCO)


Shell Sulphur Solutions

Simplot

Sinofert Holdings Limited

SQM

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Uralkali

Formed in 2007, the **International Plant Nutrition Institute** is supported by leading fertilizer manufacturers.

Its mission is to promote scientific information on responsible management of plant nutrition.

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Outline

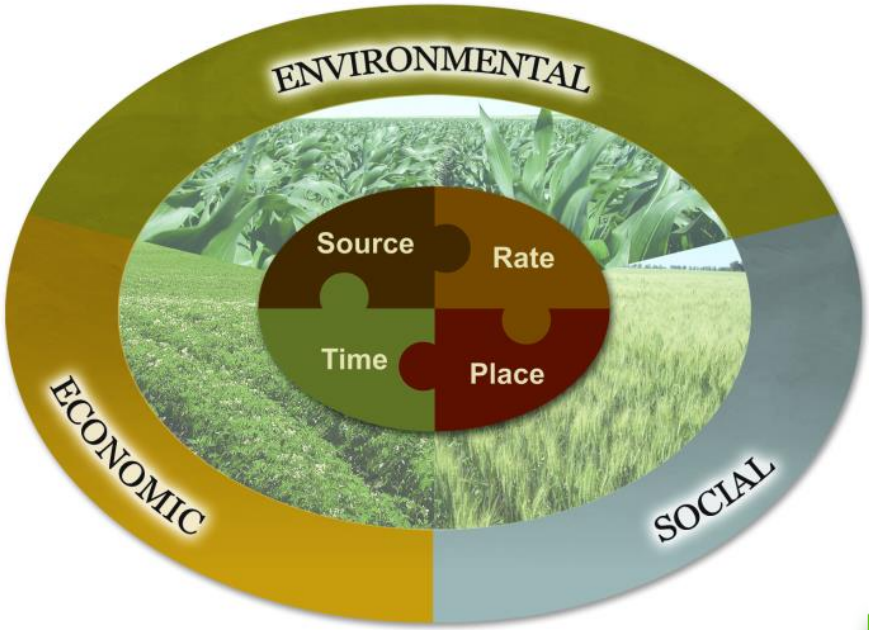
4R Nutrient Stewardship:

Improving Yields and Water Quality

- Sustainability
- Nutrient Use Efficiency
- Nitrogen
  - Adapting to weather
- Phosphorus
  - Protecting Lake Erie

- *Slides: available at* ***http://nane.ipni.net***

4R: “right” means sustainable



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Home > How To Make A Difference > Fertilizer Optimization

How to Make a Difference - Fertilizer optimization

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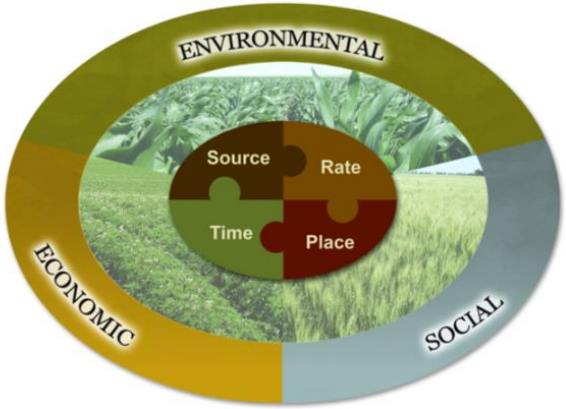
DRAFT

Nutrient Stewardship Metrics for Sustainable Crop Nutrition



Enablers (process metrics)

- Extension & professionals
- Infrastructure
- Research & innovation
- Stakeholder engagement

Actions (adoption metrics)

[Require regional definition of 4R]

- Cropland area under 4R (at various levels)
- Participation in programs
- Equity of adoption (gender, scale, etc.)

Outcomes (impact metrics)

- Food & nutrition security
- Productivity
- Nutrient use efficiency
- Land quality, soil health
- Air & water quality
- Economic value
- Land conservation, natural habitat

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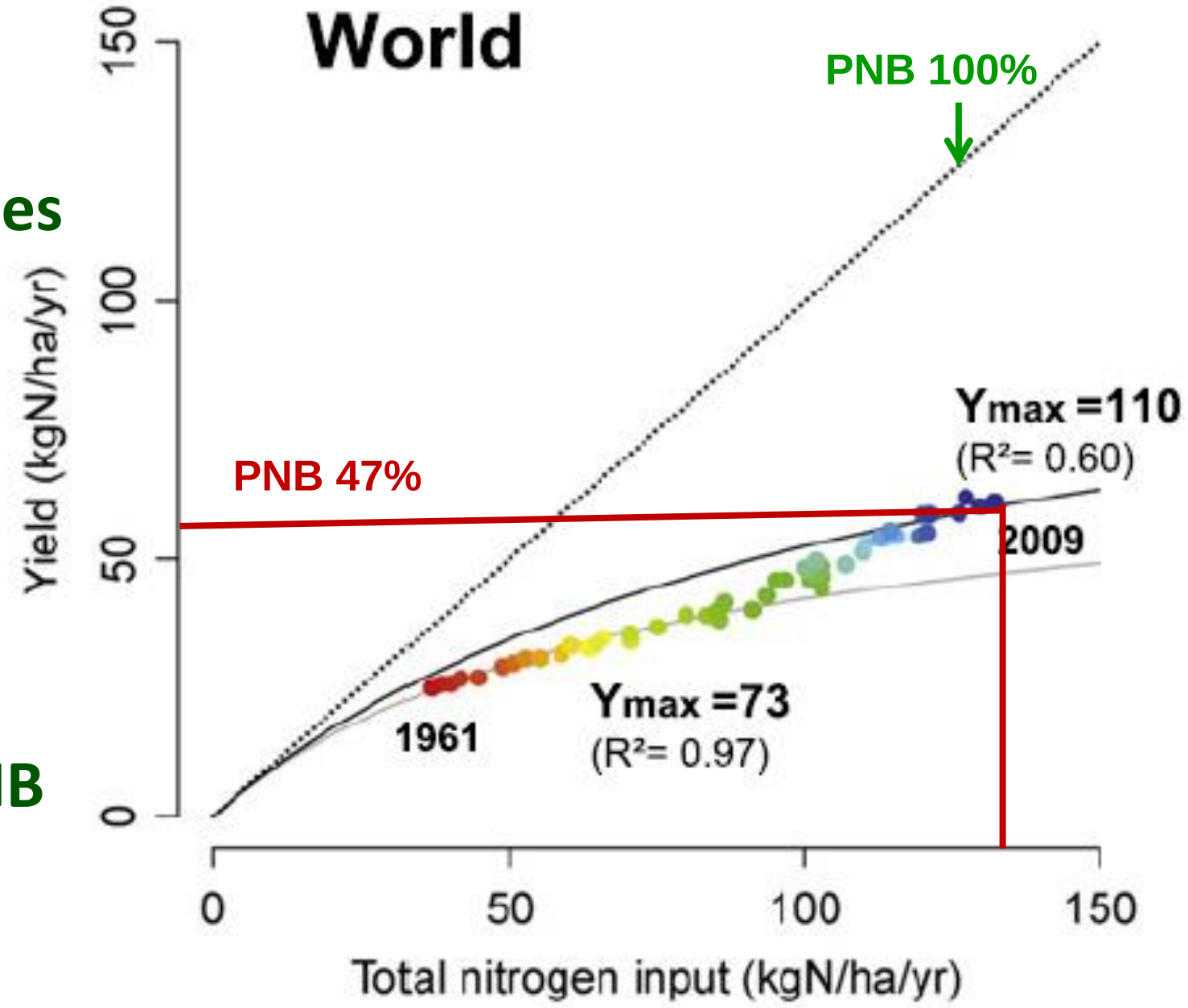
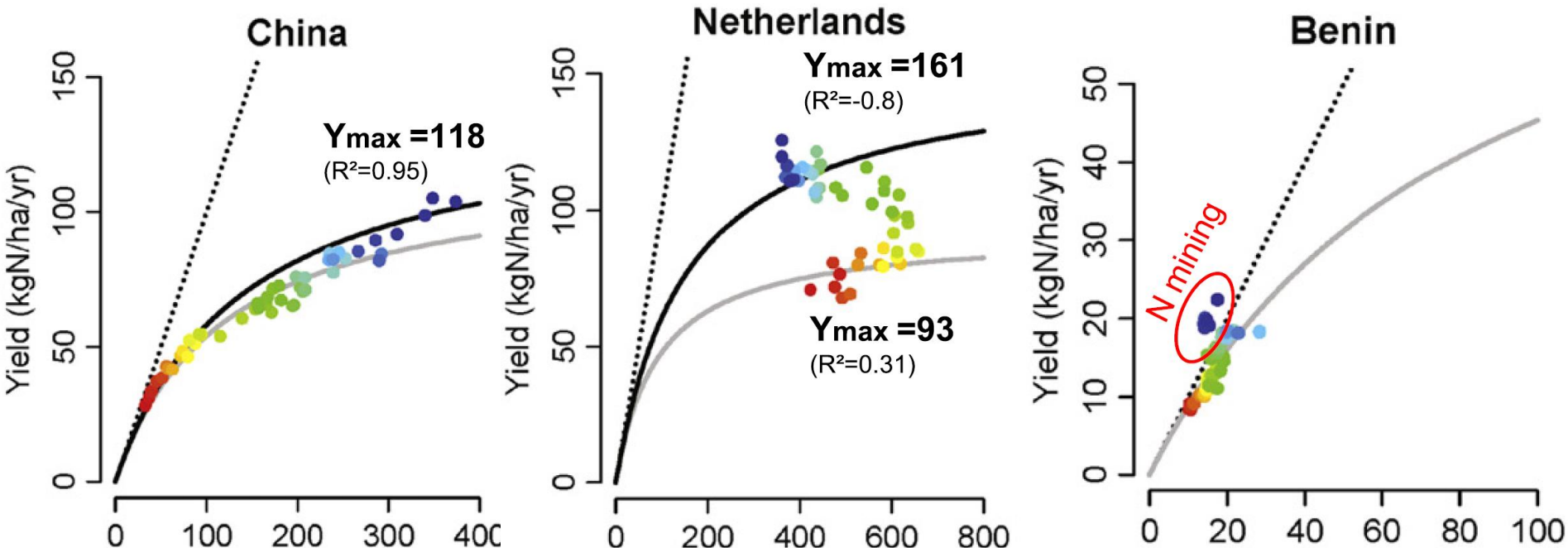
NUE trajectories over 48 years

↑ yield stable PNB



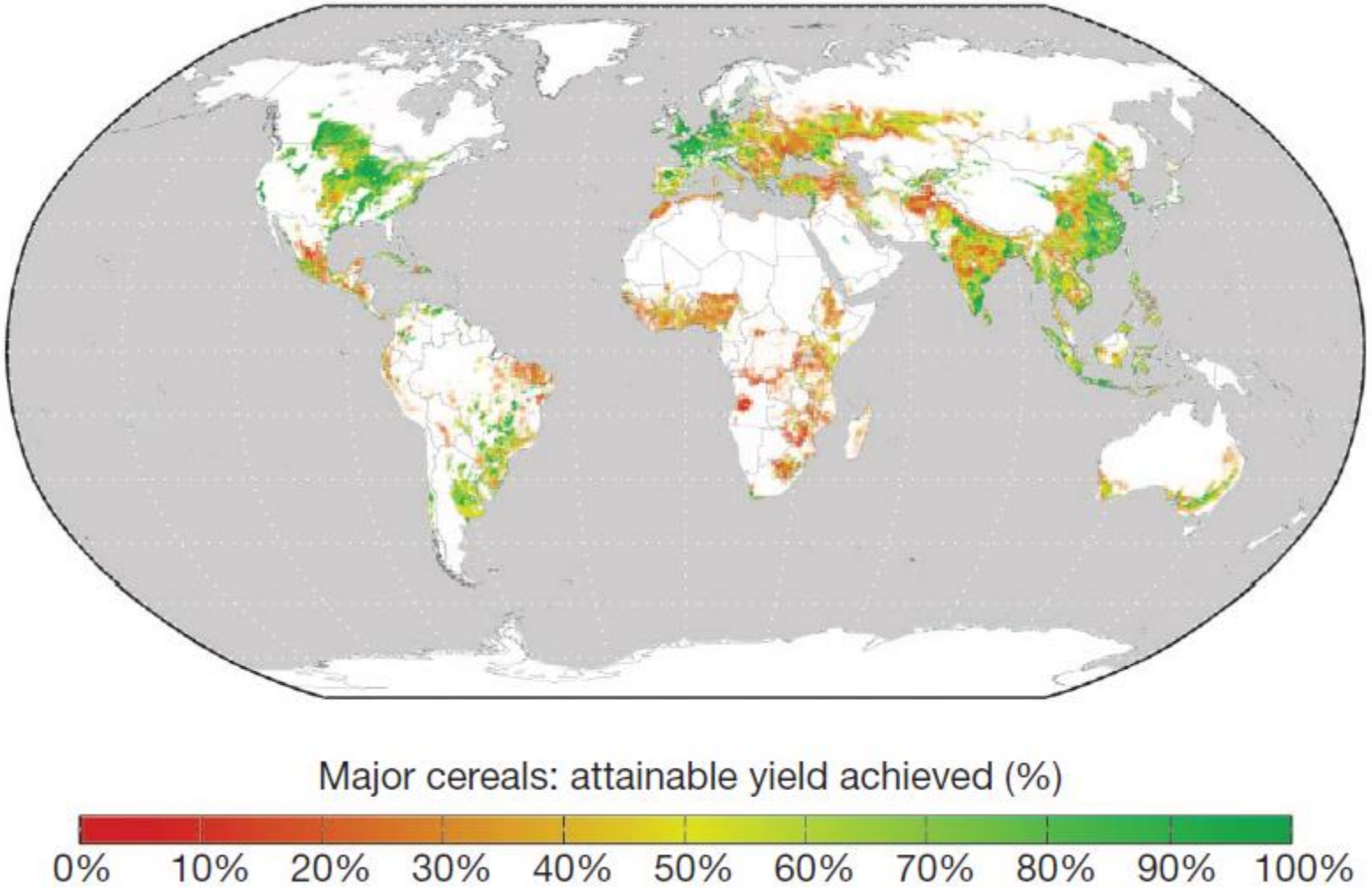
Lassaletta et al., 2014, Environ. Res. Lett. 9 (2014) 105011 (9pp)

Contrasting trajectories



Lassaletta et al., 2014, Environ. Res. Lett. 9 (2014) 105011 (9pp)

Yield gaps for maize, wheat and rice, year 2000



Mueller et al., 2012, Nature 490:254-257

Potential 4R Corn Nitrogen Practice Definitions

Level	Source	Rate	Time	Place
Basic	Guaranteed or known analysis	Rate based on LGU or adaptive management	Spring; not on frozen soil	Broadcast & incorporated, injected or subsurface band
Intermediate	+ with inhibitors if surface applied	+	+ Split application, or enhanced-efficiency source	+, or sidedress, with inhibitors if surface applied
Advanced	++	+ and using tools such as crop sensors, PSNT, Adapt-N or models	+	++

4R practices need regional, evidence-based definition

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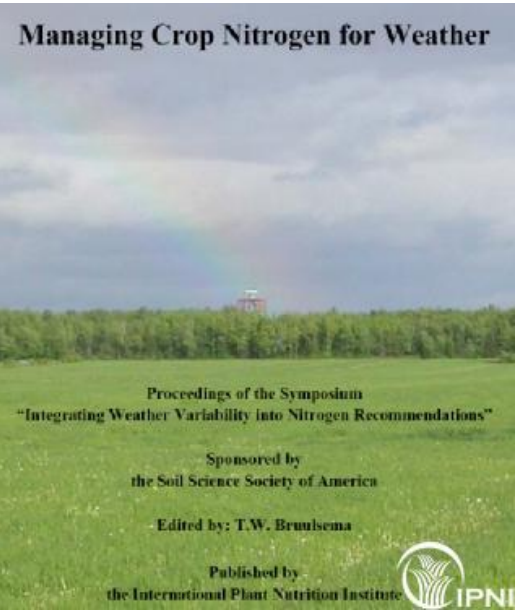
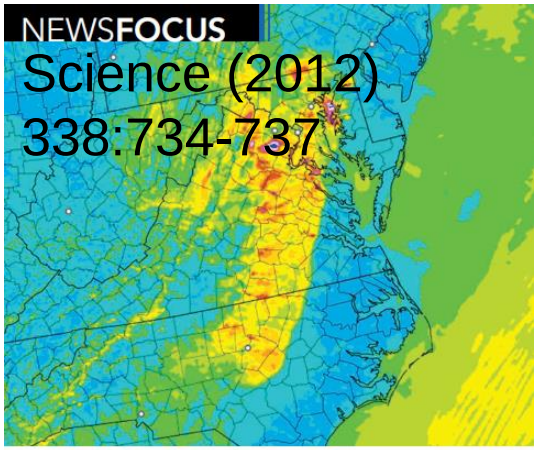
Improving nutrient use efficiency depends on adapting management to weather

❖**STRATEGY**

Support development of decision support systems that account for weather.





Weather Forecasts Slowly Clearing Up

Ever-increasing computer power and new kinds of observations are driving weather prediction to new heights, but some kinds of weather are still not yielding

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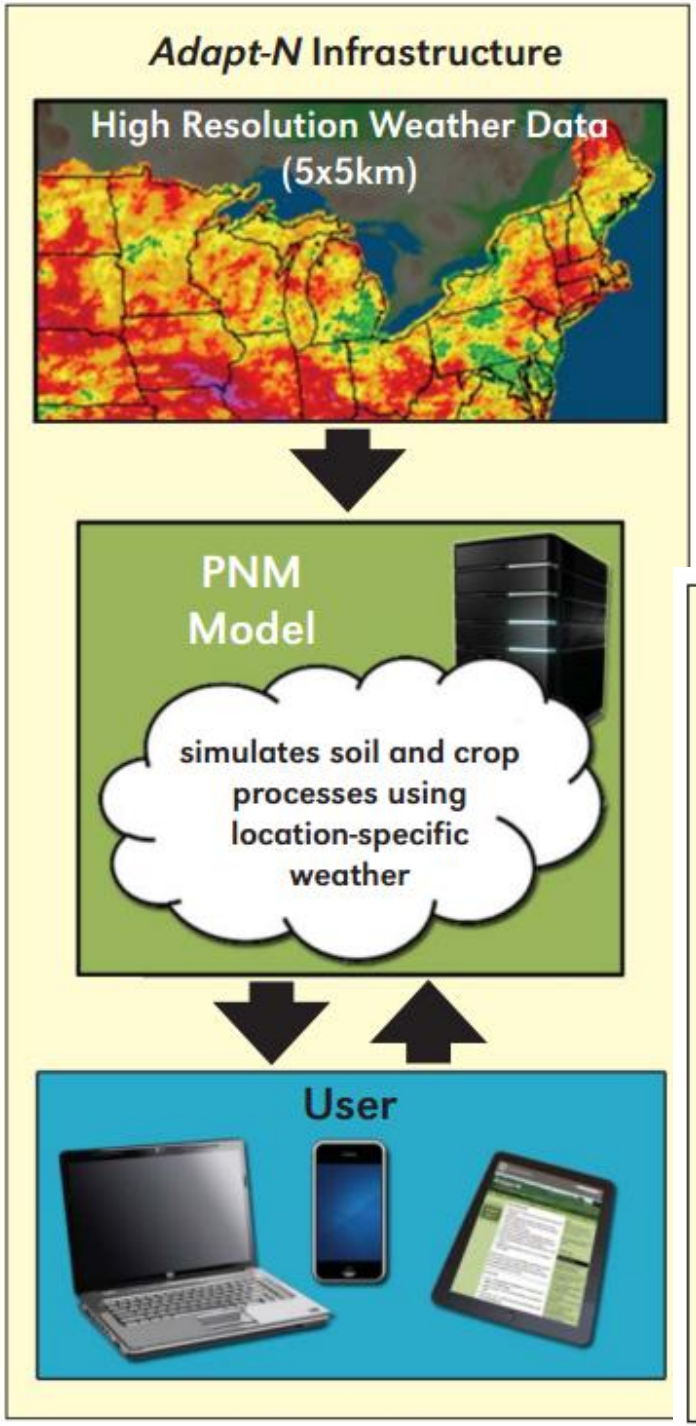
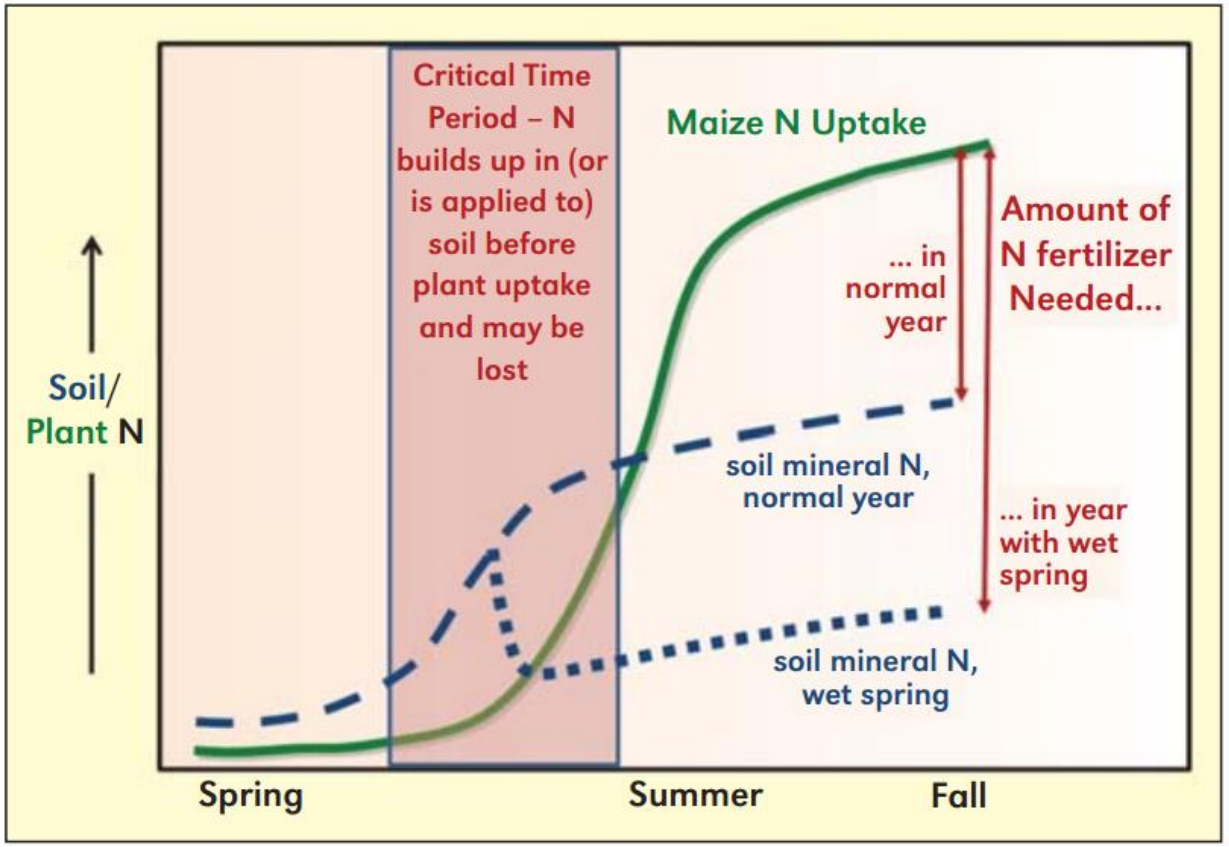
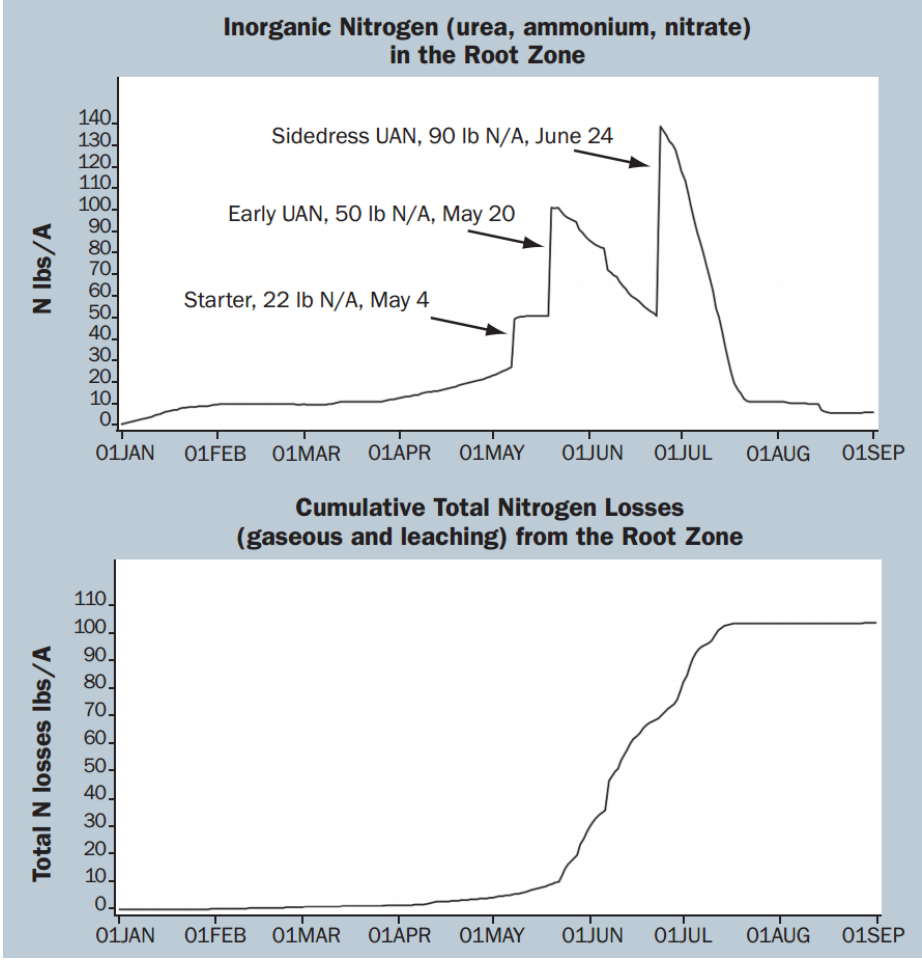
Common elements of model-based nitrogen decision support





Adapt-N validation in NY

The Richardson Farm crew (left to right): Arnold, Eric, and Ryan Richardson and Nick Humphrey.



- 2013: ↑ N rates by 20-40 lb/A, ↑ yields by 22-30 bu/A, ↑ profit $90-$120/A.
- "Arnold and sons were struck by the tool's graphs of soil N availability and rainfall, which clearly showed the farm's weather-related early N losses."
- 2011-2012: ↓ average N rates by 66 lb/A, ↑ profit by $31/A.

Ball, Moebius-Clune, van Es & Melkonian. 2014. IPNI 4R Plant Nutrition Manual Case Study 7.4-4

Many current initiatives apply models to adapt N management to weather

- Empirical – Tremblay, Kitchen, et al (2012)
- NLOS – Bittman & Hunt, Agriculture and Agri-Food Canada
- Climate Corp – Monsanto
- Encirca Yield – DuPont-Pioneer
- 360 COMMANDER – Gregg Sauder
- Adapt-N – Cornell U and Agronomic Technology Corp (ATC)

Willard Agri-Service – DE & MD

Eco N®
an ecological nutrient system

- John Dantinne and Mike Twining
- Branding: Eco-N (Adapt-N agreement with Cornell, ATC)
- 2014: >150 fields, at least one field for each sales rep. Growers generally pleased with recommendations, yields up to 240 bu/A
- Compared to other approaches to N management (PSNT, CSNT, sensors): **more potential to implement commercially; more comprehensive**
- Toughest challenge: **tracking applications**
- Why Adapt-N? 1) university-based, 2) developed for East Coast, 3) scientist engagement – visits to the field
- Expect recs to improve within 3 years

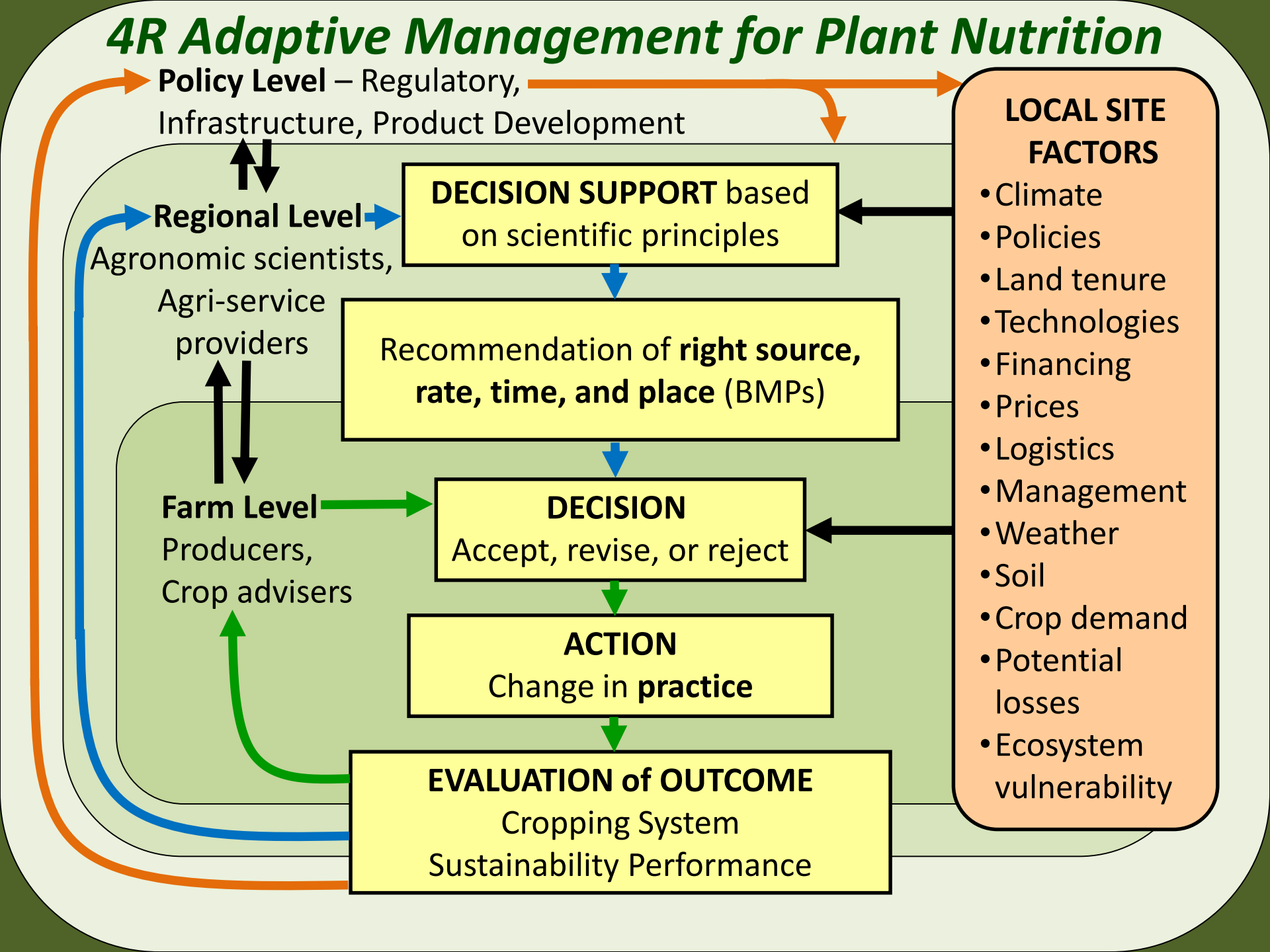
WILLARD
nourishing earth for life

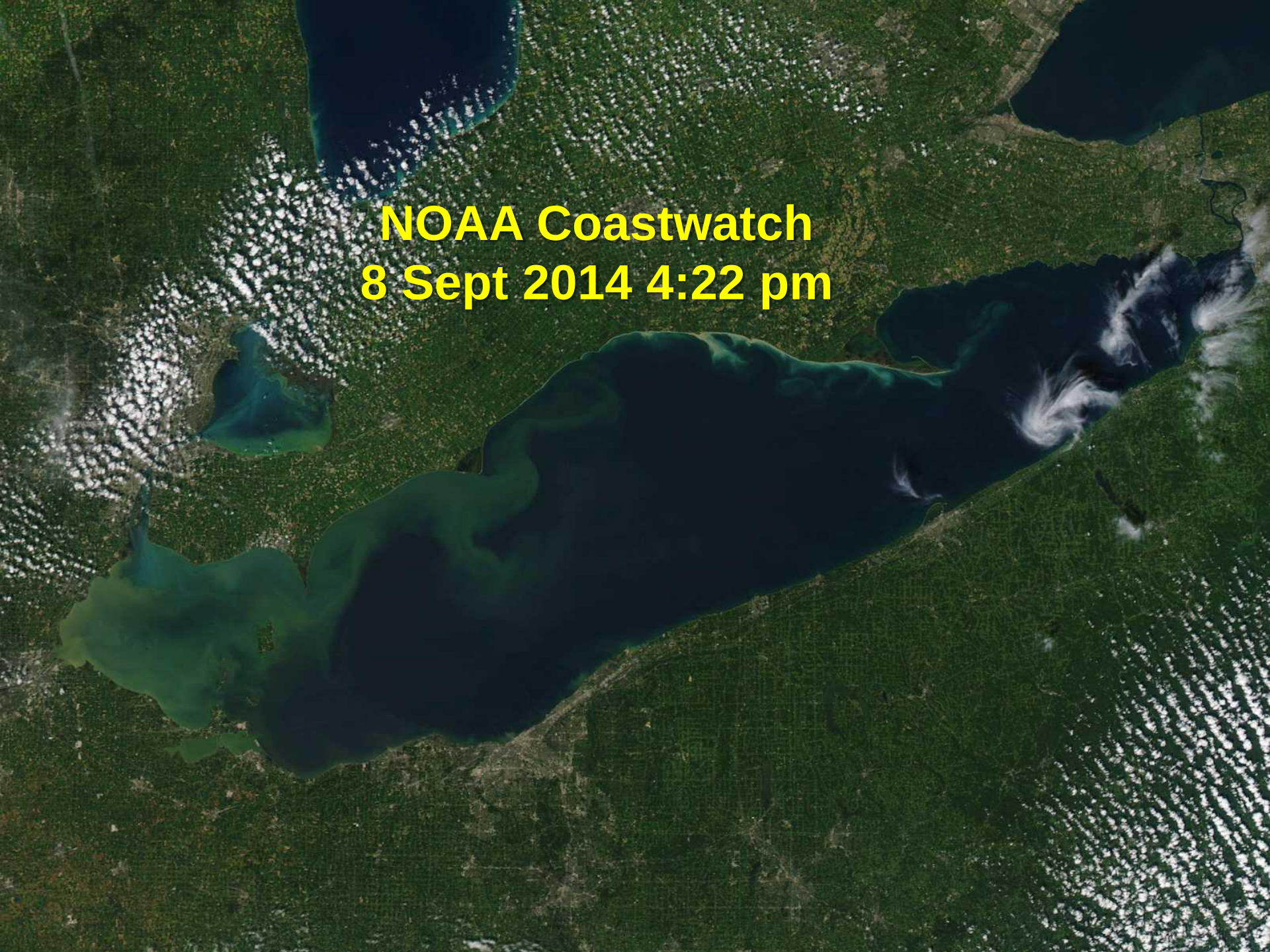
Dantinne, J. October 2014.

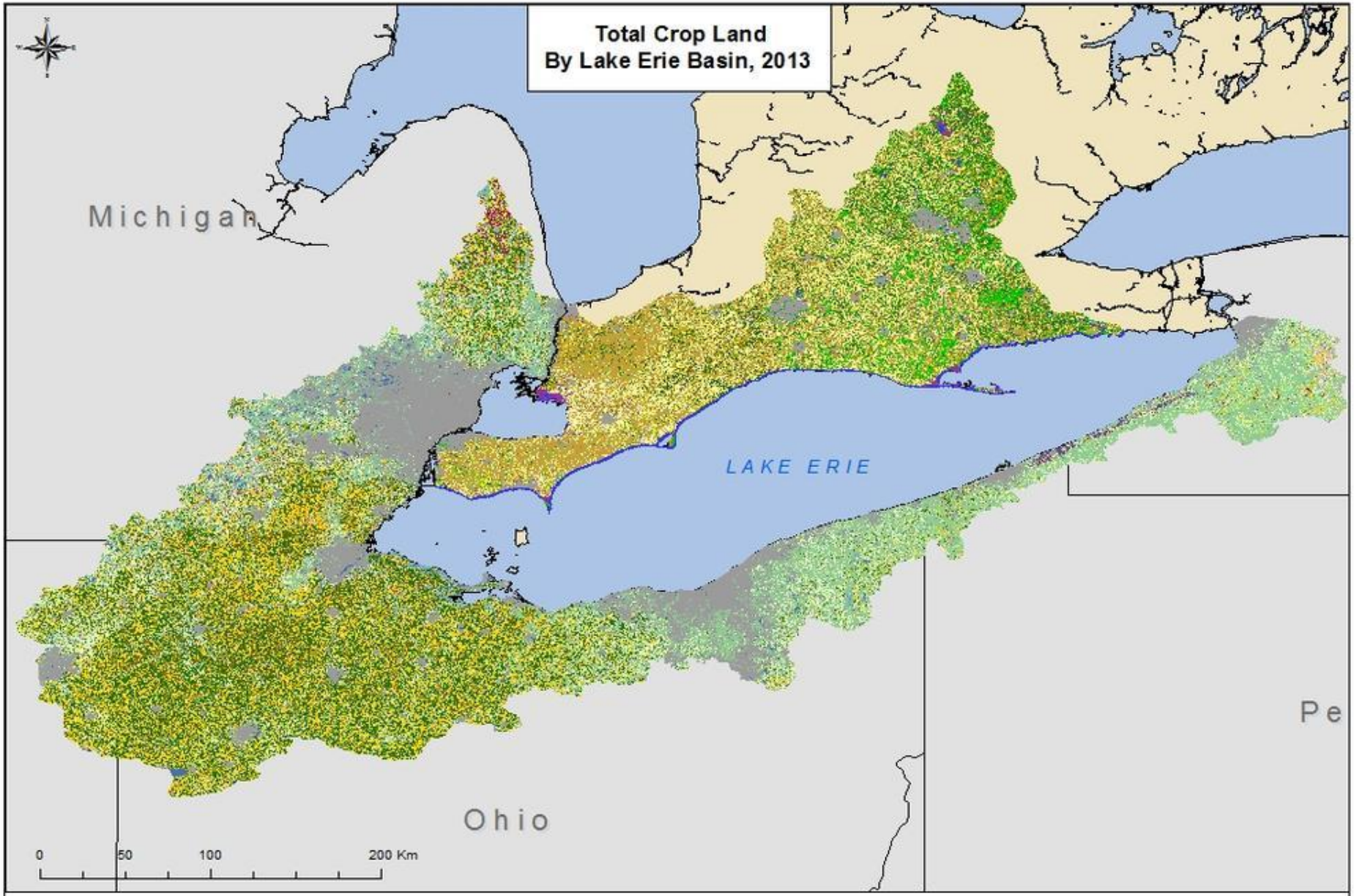
Learnings from on-farm N modeling experiences

- Corn growers are finding value from split N applications, even with preplant rates > starter.
- Many alternative methods (e.g. PSNT, sensors) are much more difficult to implement than a model.
- Growers can learn from a process-based model.
- Models are only one tool. Still need to scout!
- Scientists developing technologies need to be engaged in the on-farm validation .

4R Adaptive Management for Plant Nutrition




NOAA Coastwatch
8 Sept 2014 4:22 pm



Total Crop Land in Lake Erie Basin, United States of America: 47, 167194 acres

Total Crop Land in Lake Erie Basin, Canada: 23, 674011 acres

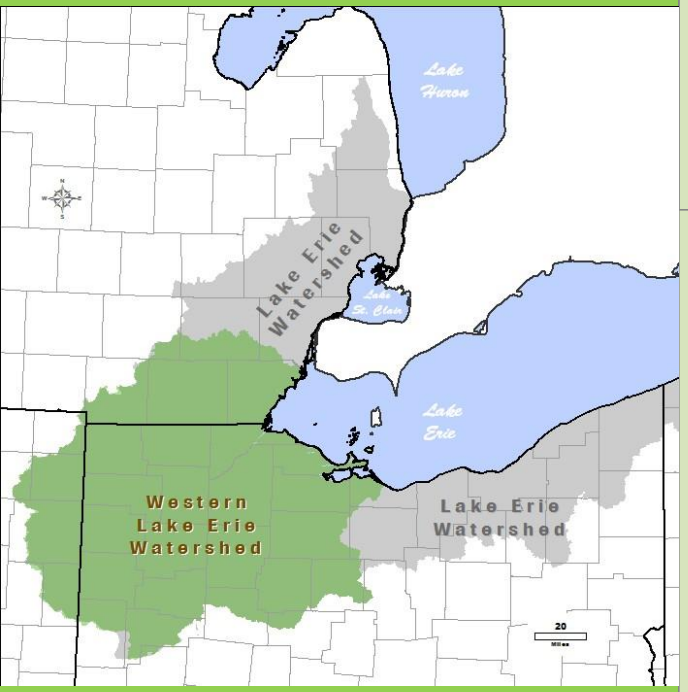
This map is for illustrative purposes only. Do not rely on it as being a precise indicator of routes, locations of features, or as a guide to navigation. This map may contain cartographic errors or omissions.

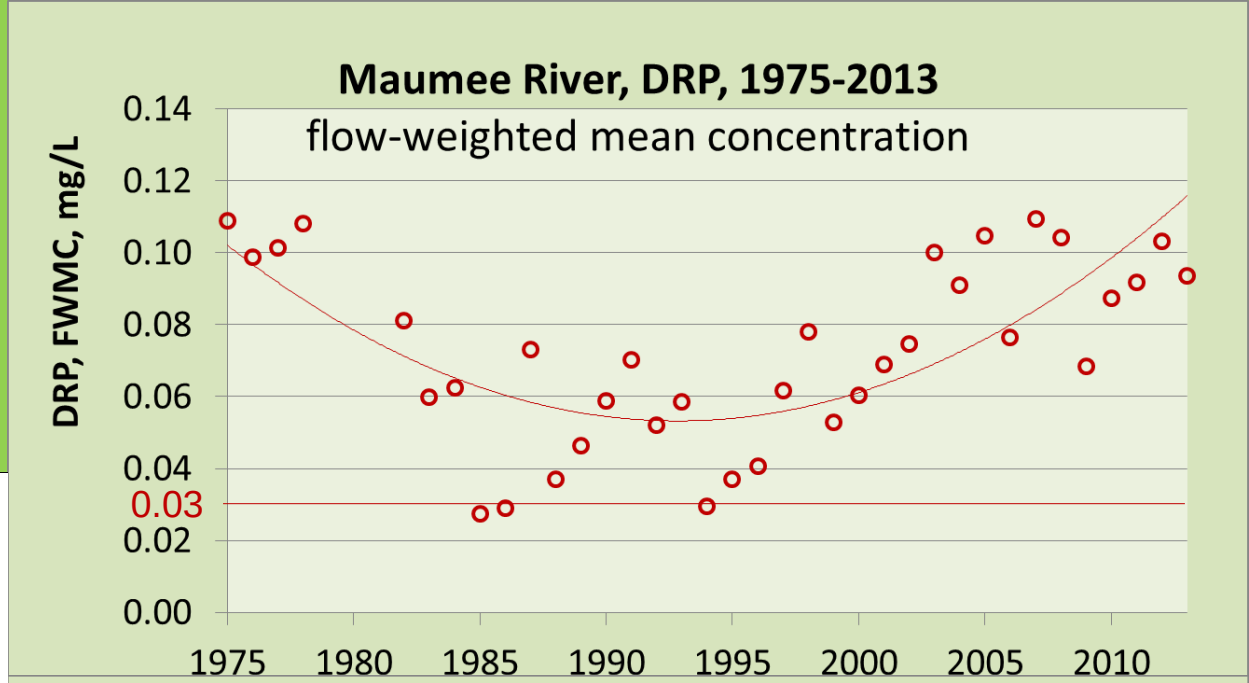
Map data compiled from 2013 Agriculture and Agri-Food Canada Crop Layer, Statistics Canada and 2013 National Agricultural Statistics Service, United States Department of Agriculture

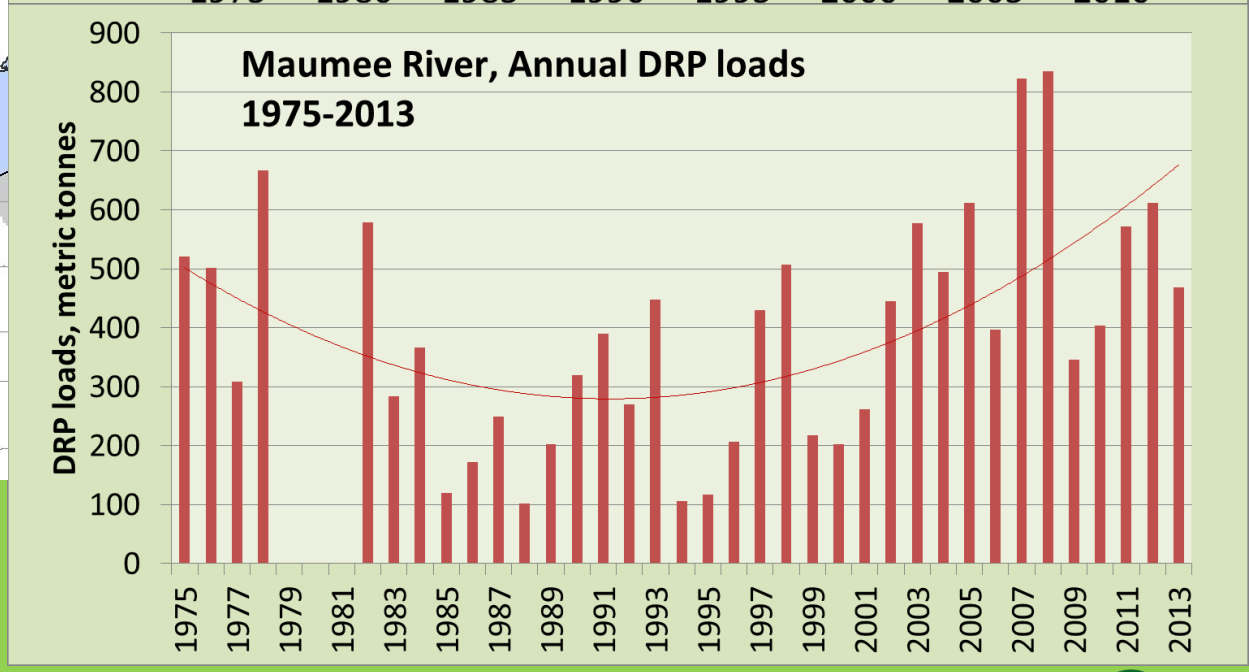
Projection: WGS 84
Datum: World Geodetic System 1984

Ontario

Western Lake Erie: DRP trends worsening since 1992







David Baker et al., National Center for Water Quality Research, Heidelberg U, Tiffin, OH

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So what could be causing the trend of increased losses of dissolved P?

- Weather patterns
- Tillage trends
- P application
  - Source?
  - Rate?
  - Time?
  - Place?

USGS monitoring gauge, Waterville, Ohio, 31 July 2012

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9 factors that influence subsurface phosphorus transport to tile drains

management
1. P source
2. P placement
3. P application rate
4. P application timing

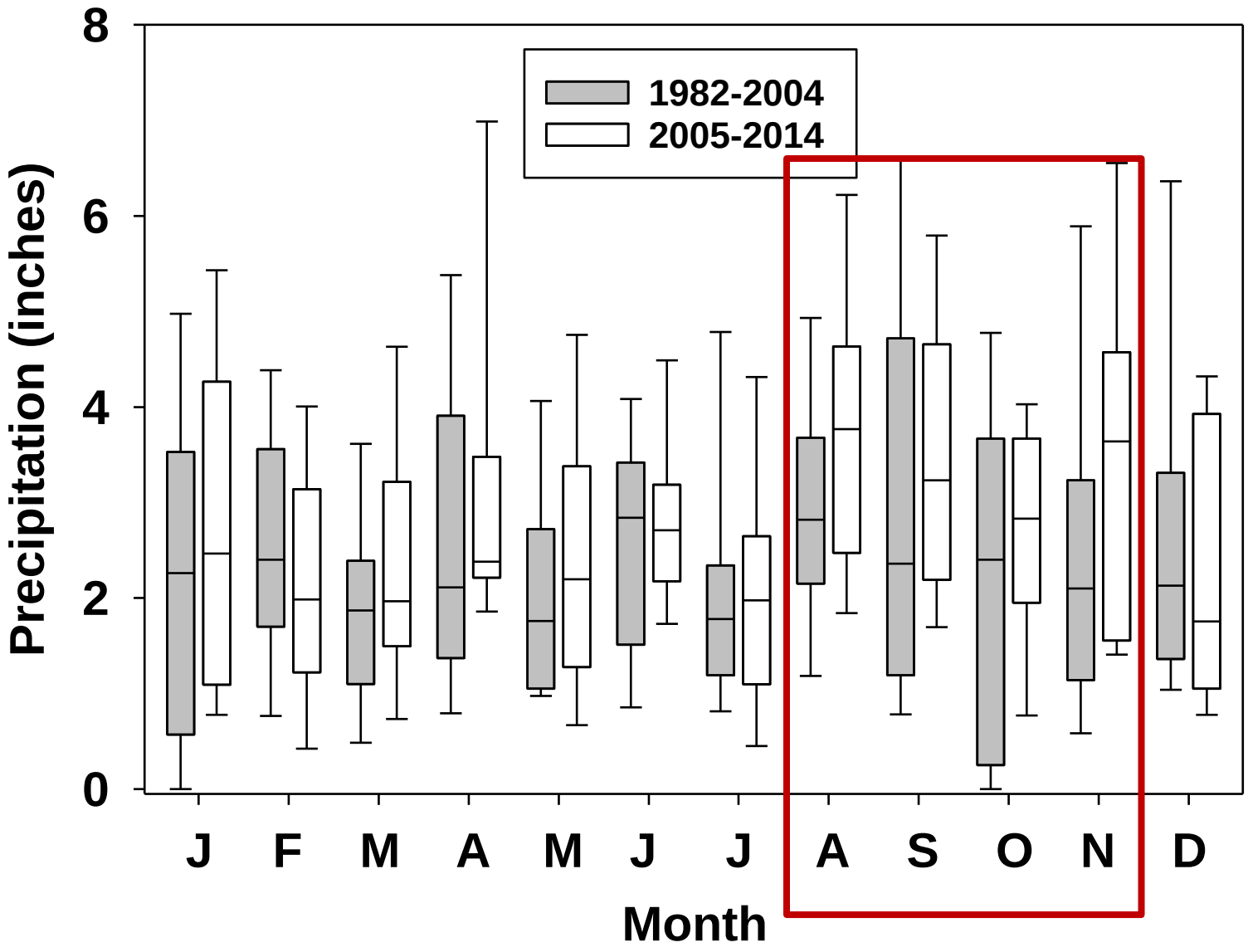
soil
5. Soil test P concentration
6. Soil P sorption capacity

transport
7. Preferential flow pathways
8. Drainage depth and spacing

climate
9. Hydrology and season

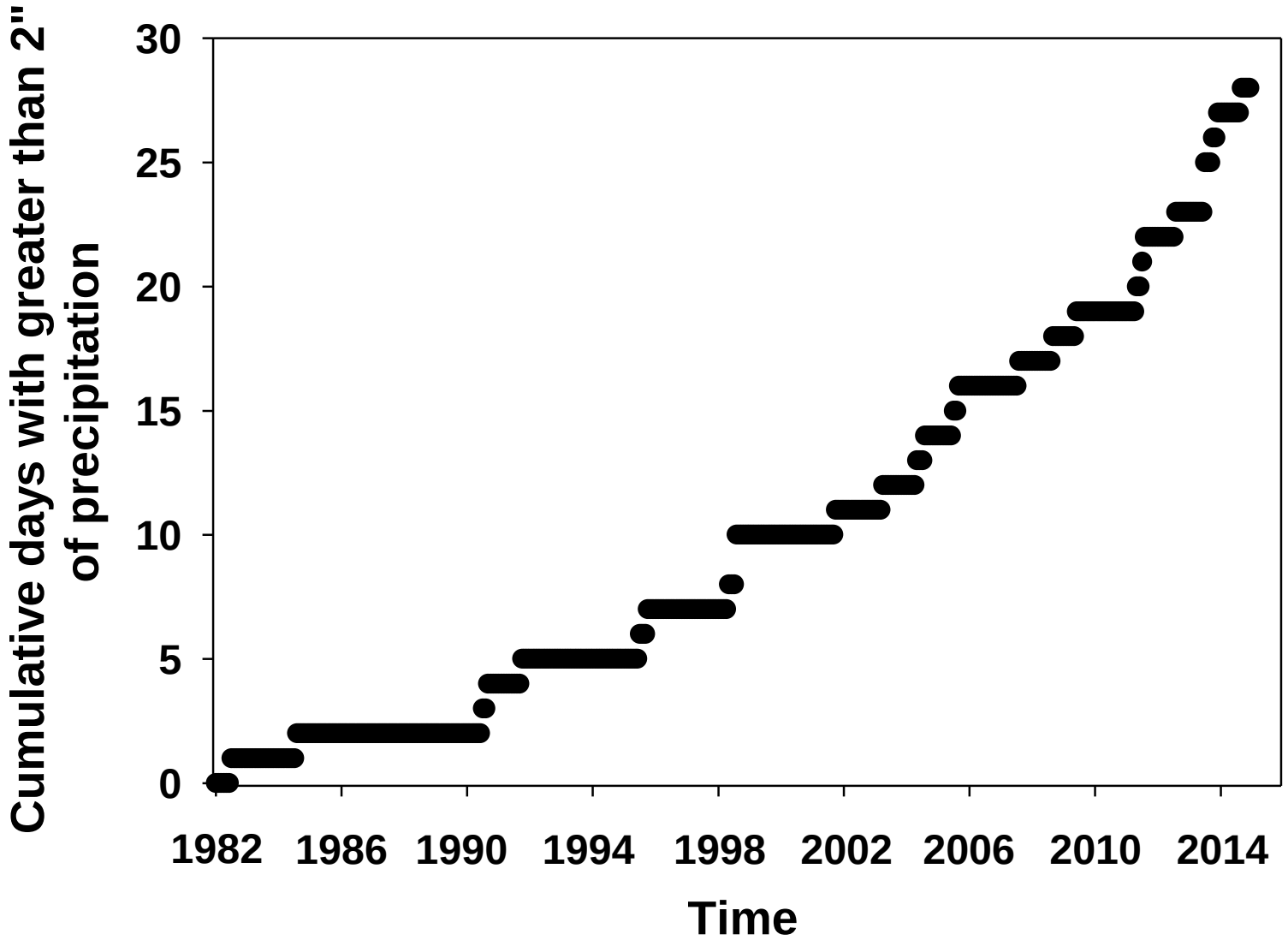
"The loss of P is a function of, but not exclusively of, any one factor."
McDowell and Sharpley (2001)

Precipitation Trends – Ohio



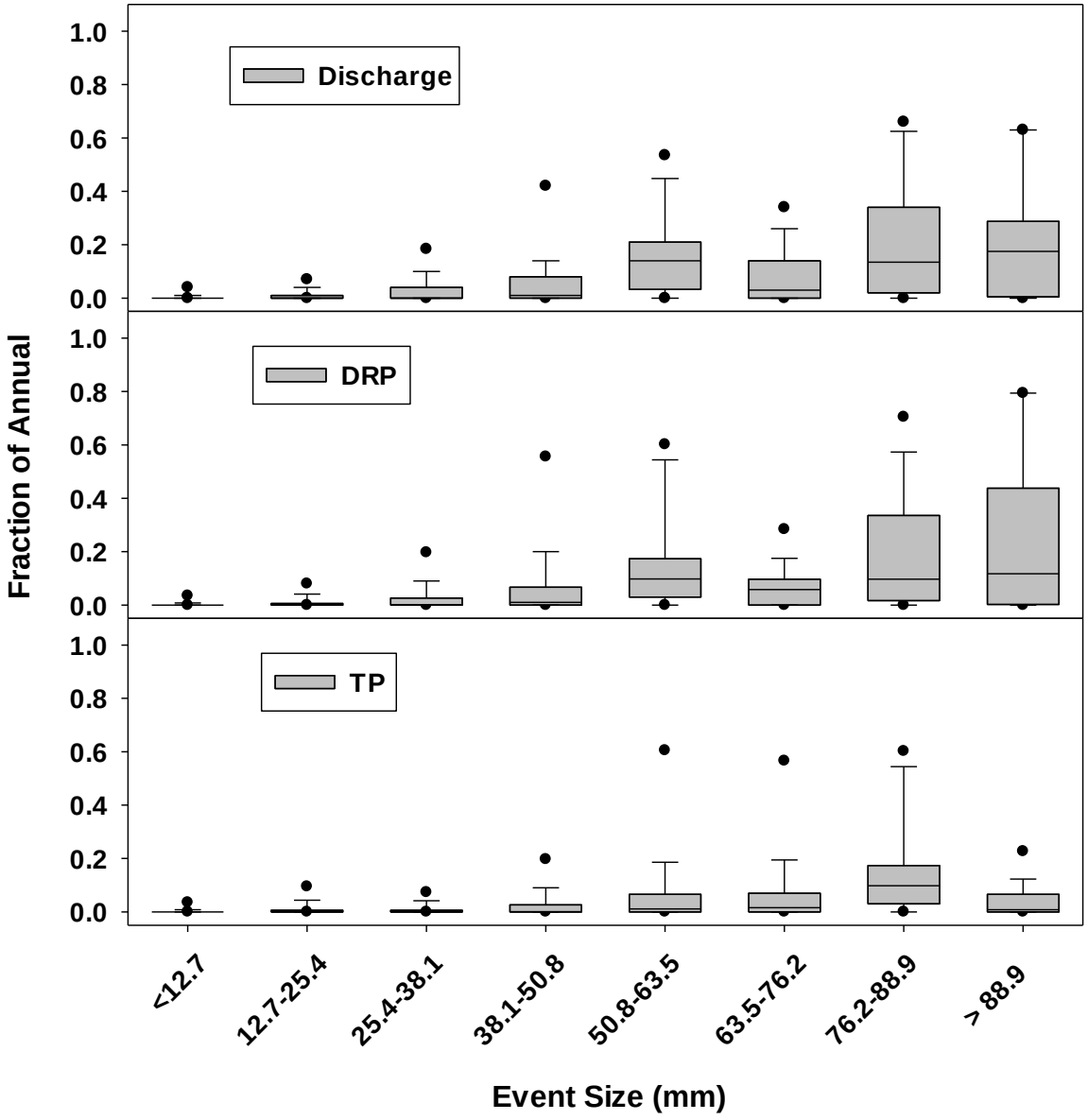
Kevin King, USDA-ARS, Columbus, Ohio

Frequency of days with >2” rain is increasing



Kevin King, USDA-ARS, Columbus, Ohio

Effect of event size on surface losses



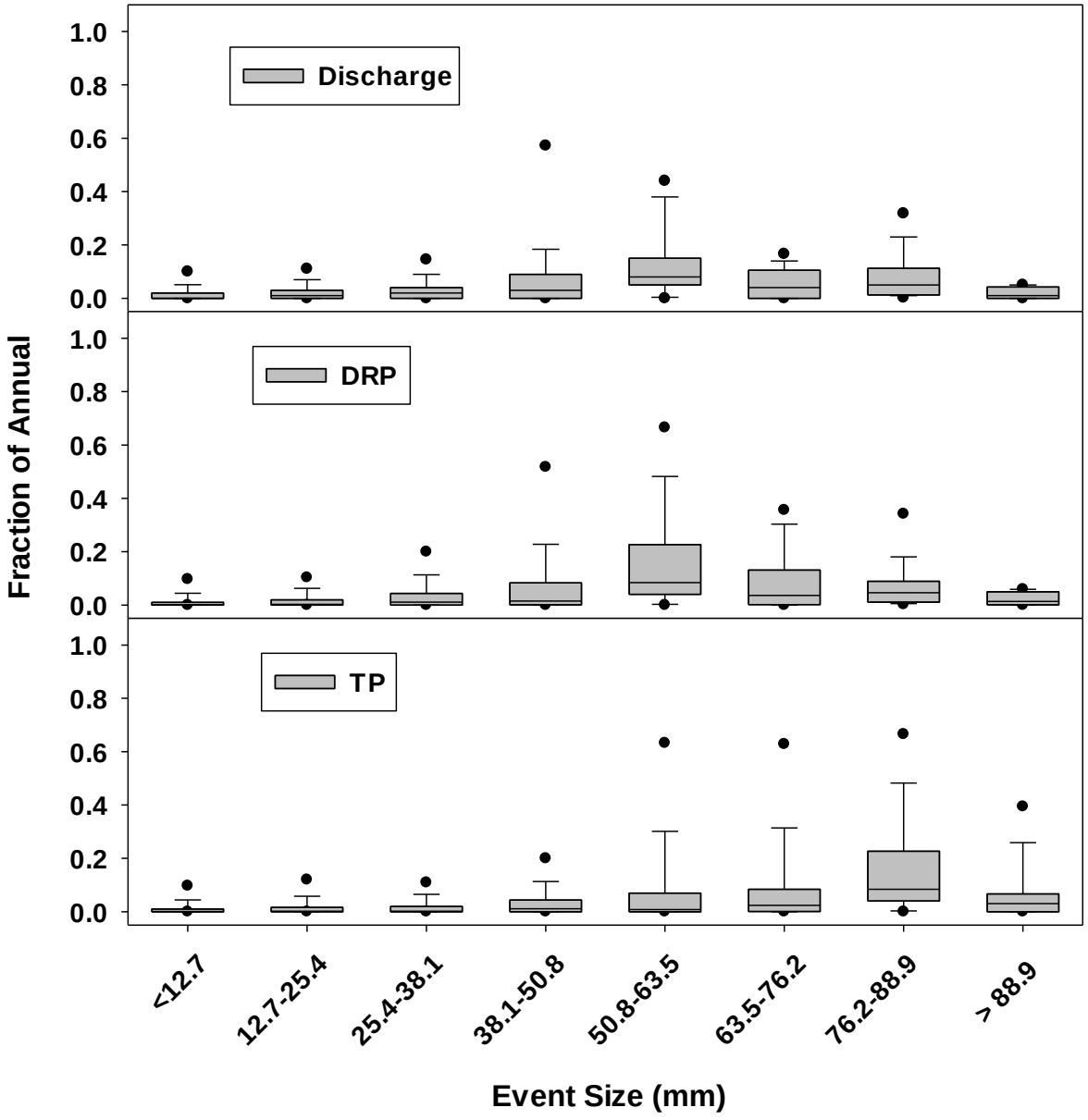
2094 rainfall events greater than ¼”

Across all sites, rainfall events > 2” accounted for:

- **64% of DRP load**
- **65% of TP load**

Kevin King, USDA-ARS, Columbus, Ohio

Effect of event size on tile losses

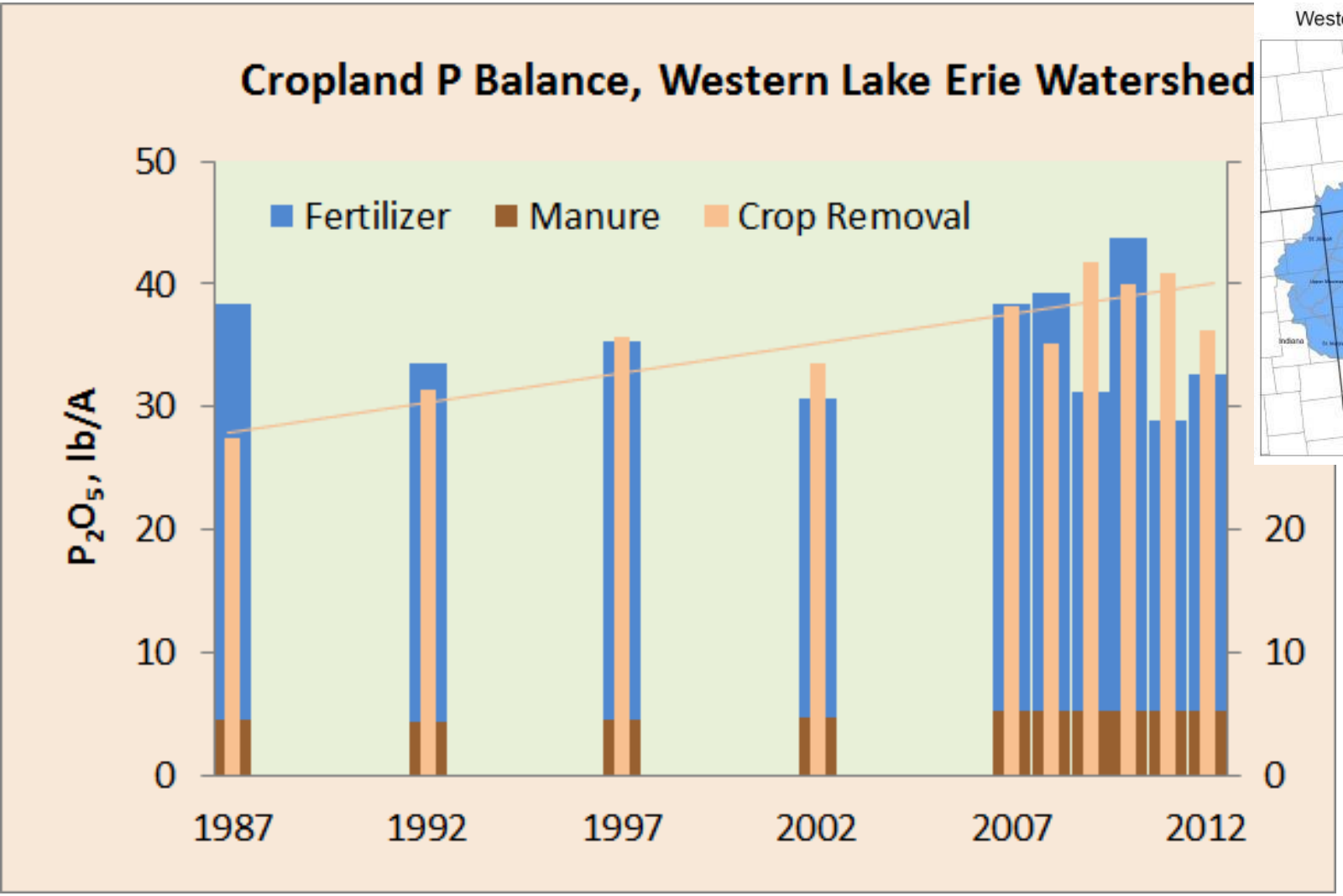


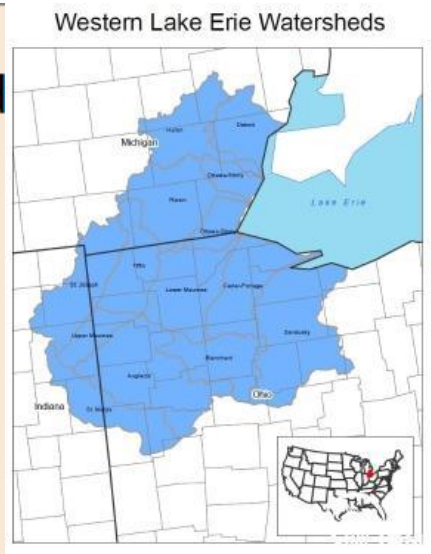
1601 rainfall events greater than ¼”

Across all sites, rainfall events > 2” accounted for:

- **33% of DRP load**
- **33% of TP load**

Kevin King, USDA-ARS, Columbus, Ohio





1. Application rates short of crop removal since 1991.
2. Crop removal is increasing with yield.

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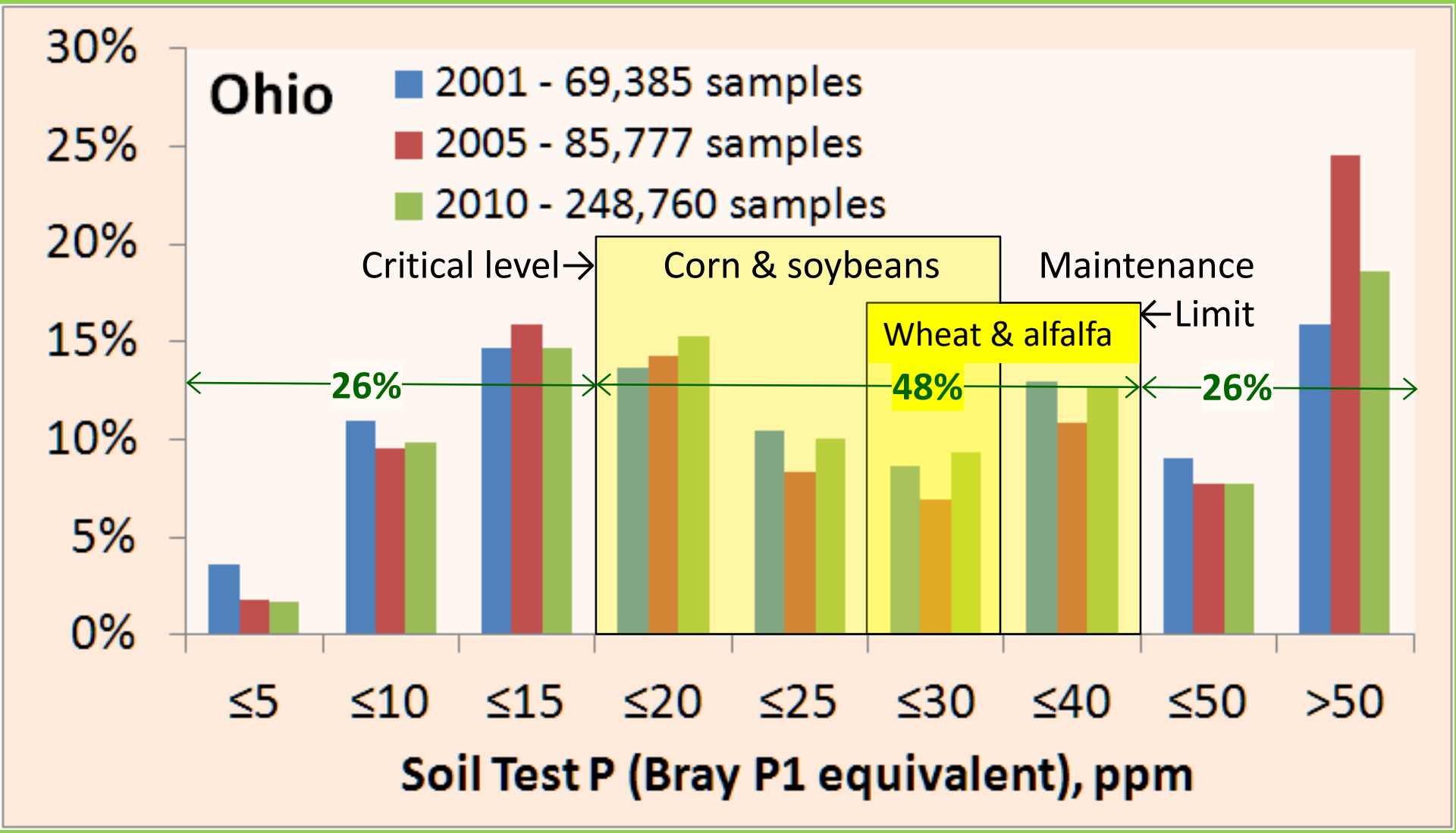
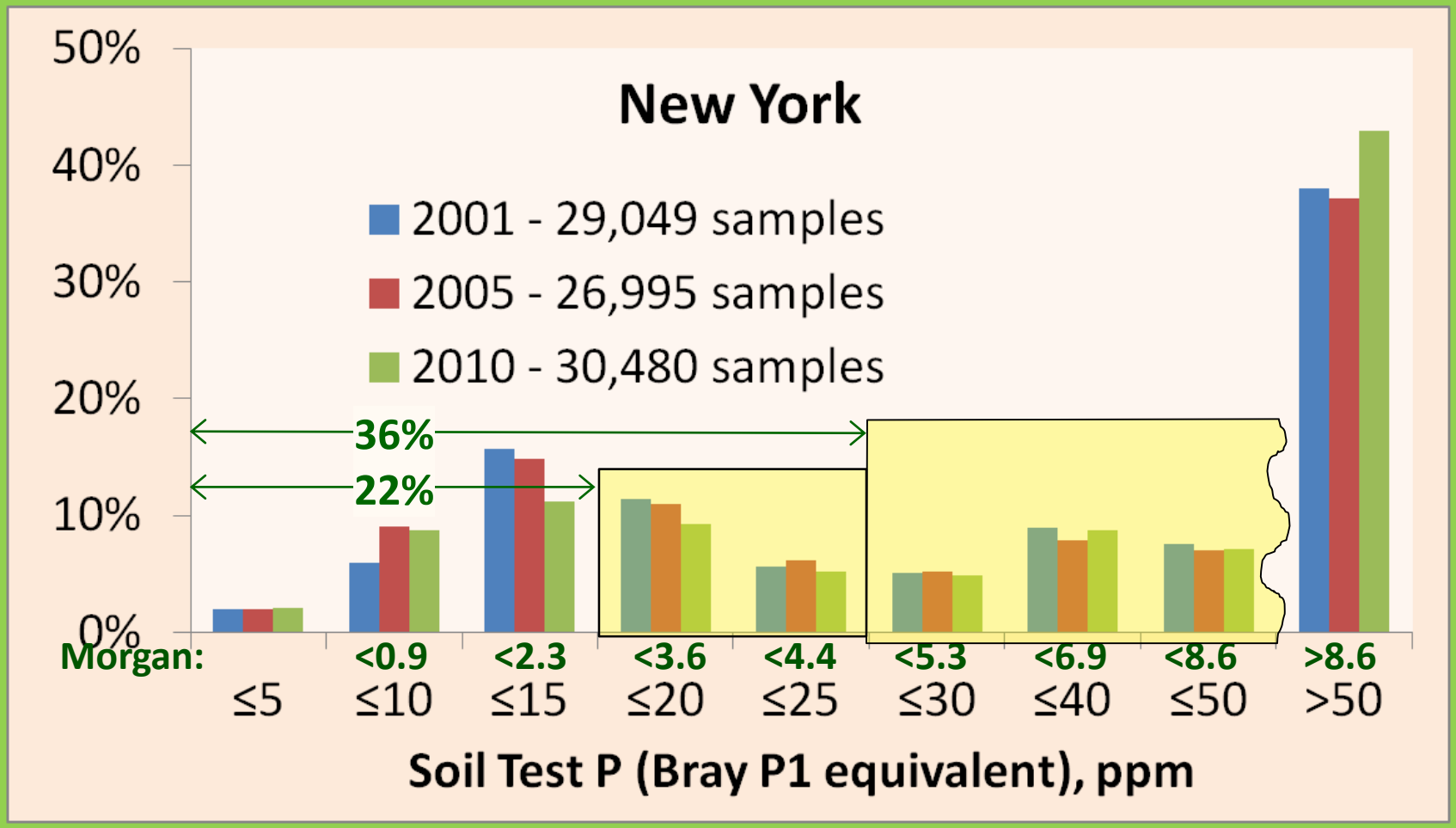
NuGIS
Nutrient Use Geographic Information System

48% of Ohio soils test optimum for P

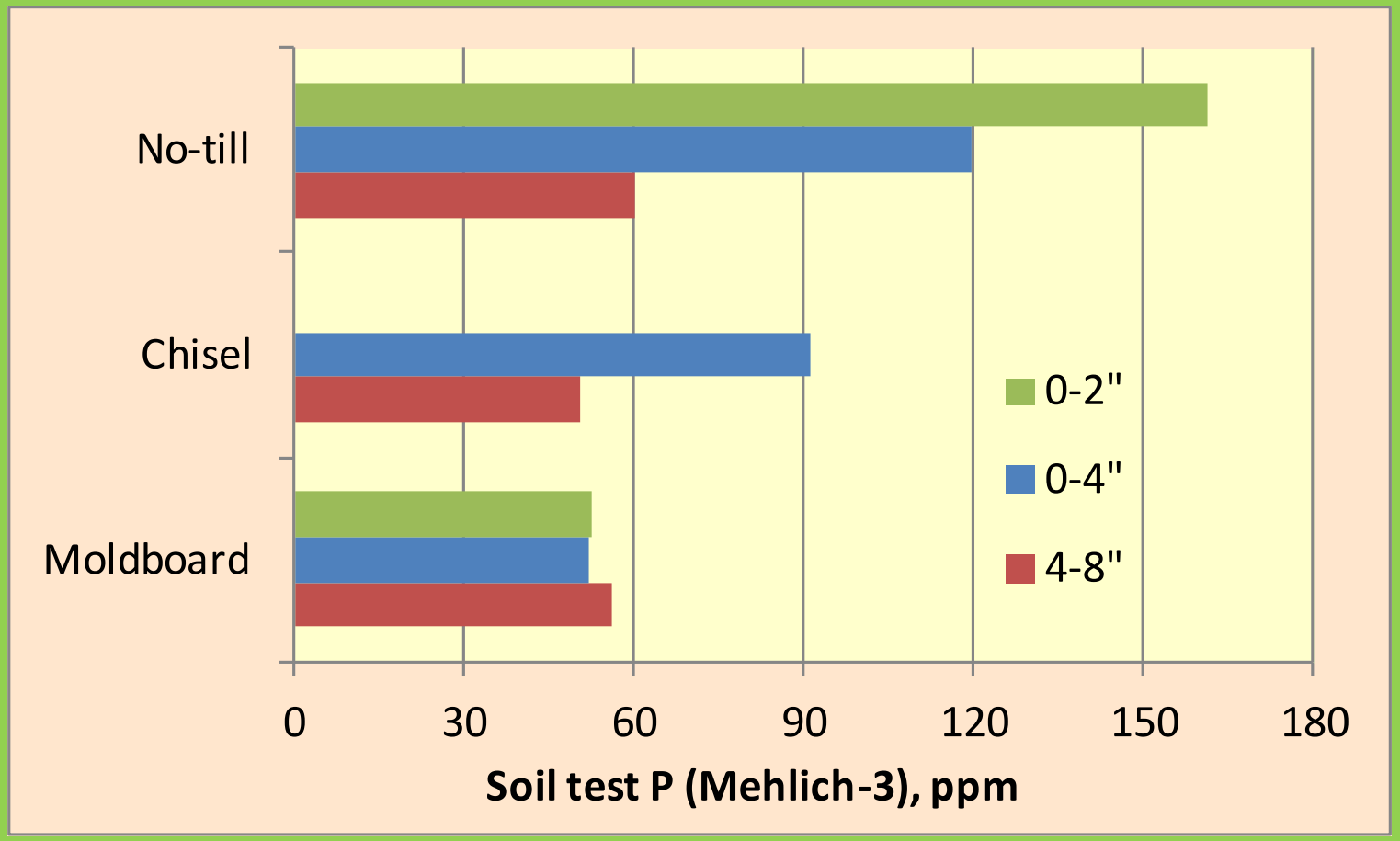


Soil test P distribution, 2001-2010

New York soils test a little higher for P

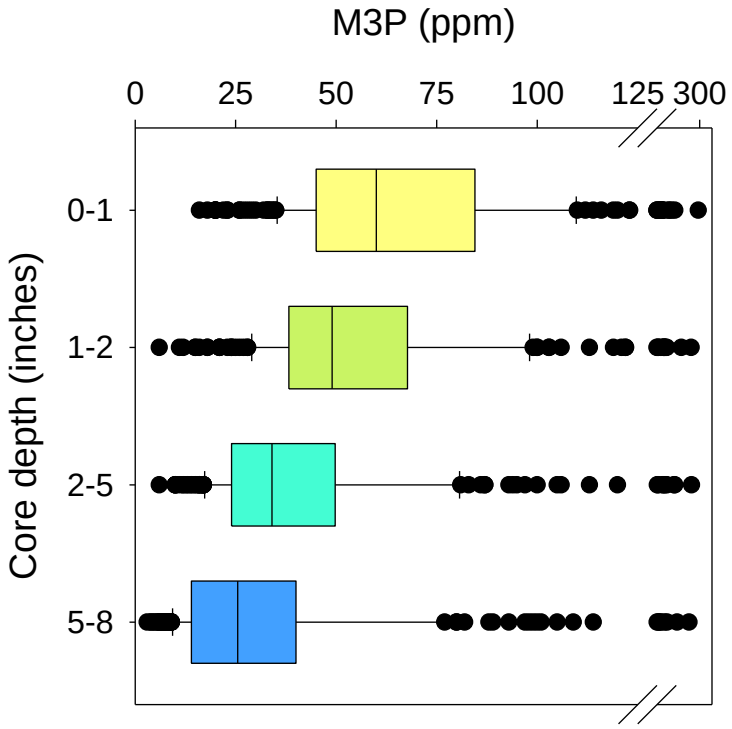


Soil test P stratifies without moldboard plowing



Soil test P distribution with depth in a long-term tillage experiment on a poorly drained Chalmers silty clay loam soil near West Lafayette, Indiana. Moldboard and chisel plots were plowed annually to a depth of 8”. Data from Gál (2005) and Vyn (2000). Fertilizer P applied broadcast.

4-part stratification



Median

60

49

34

26

0-8”
36 ppm

60/36 = 1.7

- **Stratification evident even in the top 1” of soil (ANOVA, P<0.001, n=232)**
- **Although the degree of stratification varied some…**
- **85% of the samples had some degree of stratification**

Kevin King, USDA-ARS, Columbus, Ohio

Source: Johnson and Baker, Heidelberg University

Effect of tillage on preferential flow and phosphorus transport

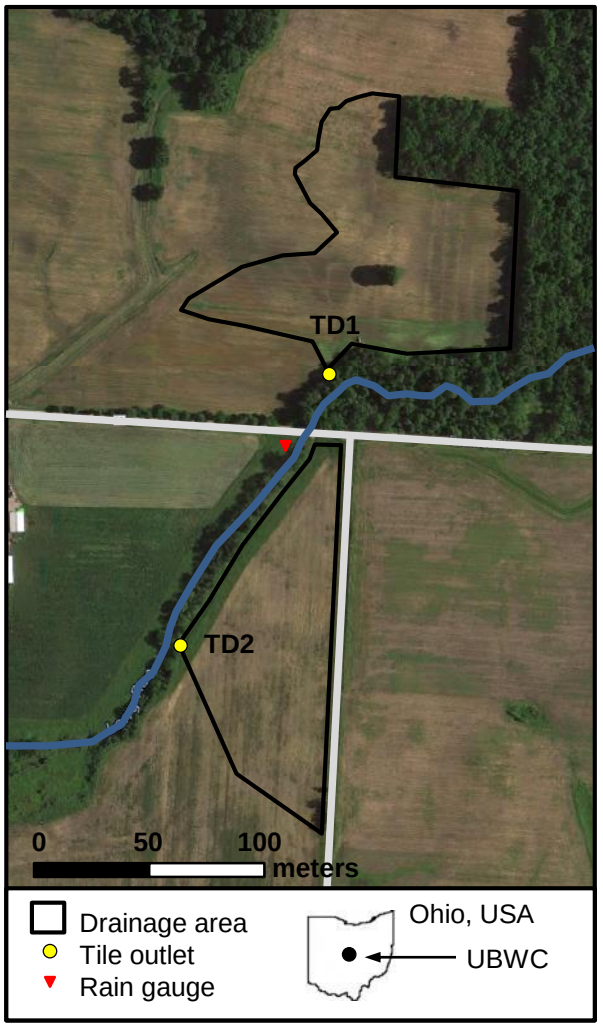
Soil type: Silt loam
Tile depth: 3 ft
Soil test P: 30 ppm Mehlich-3P
Tillage: No-till

2014 management

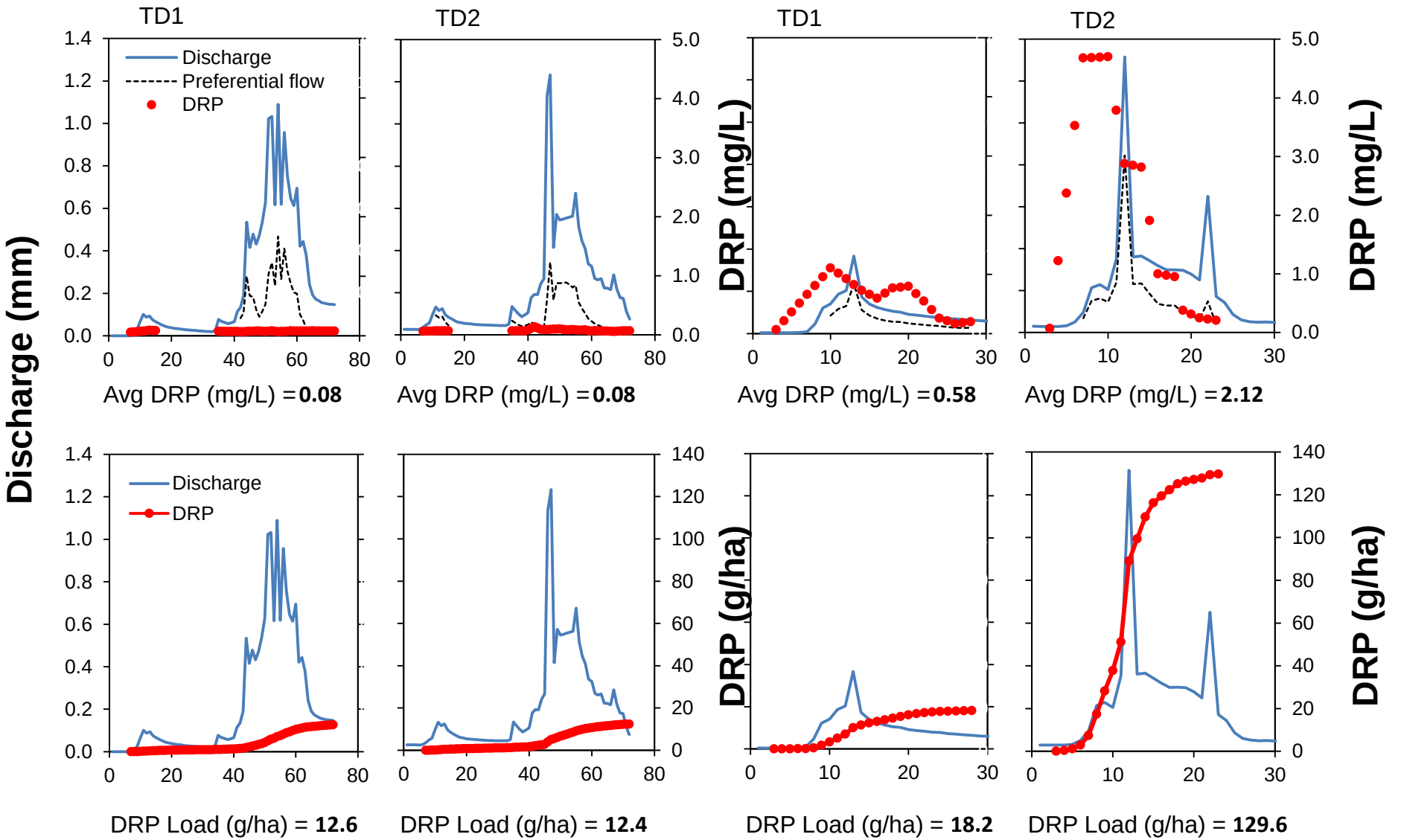
May 6th – Applied 175 lb/ac of MAP
May 8th – Tilled field TD1 (disc)
(TD2 remained no-till)

Study Objective

Compare P transport before and after tillage and between tilled and no-till fields

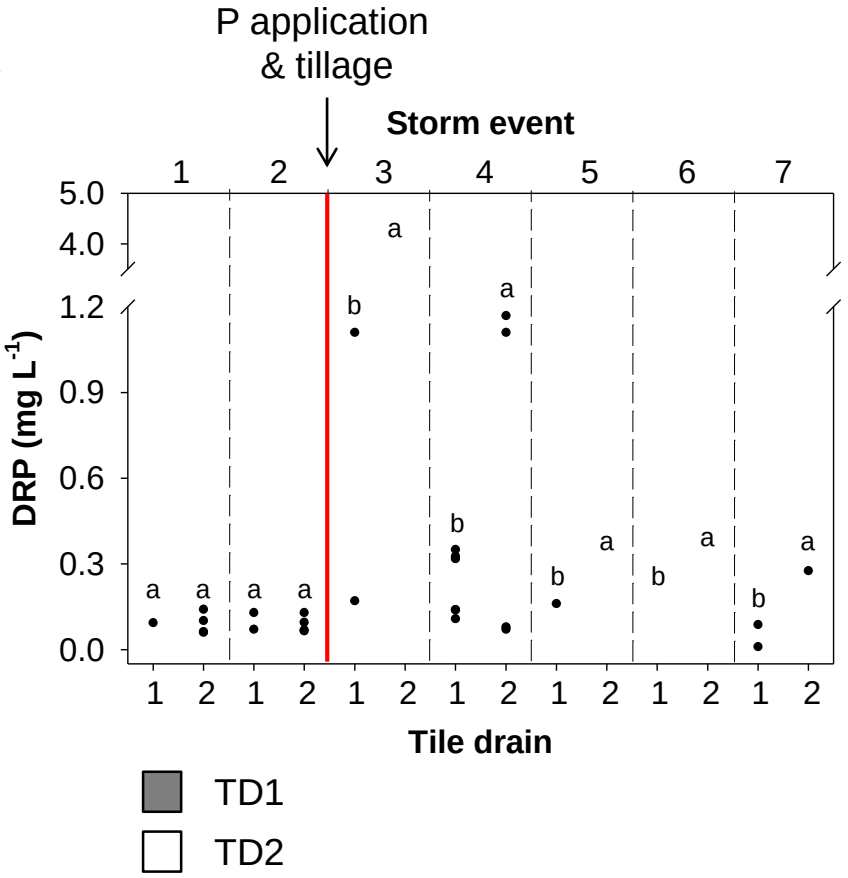


Kevin King, USDA-ARS, Columbus, Ohio



Kevin King, USDA-ARS, Columbus, Ohio

DRP concentrations in tile discharge remain greater from the no-till field compared to the tilled field even after 5 storm events (>1 month)



Incorporating the fertilizer substantially decreased DRP loads in tile drain discharge

Storm Event	TD1 (inc)	TD2 (surface)
	lb P_2O_5 per acre	
1	0.026	0.025
2	0.034	0.040
3	0.037	0.264
4	0.112	0.429
5	0.003	0.008
6	0.001	0.003
7	0.004	0.008
Total	**0.217**	**0.778**

Kevin King, USDA-ARS, Columbus, Ohio

Fall Strip-till Banding

- Puts the P in the soil
- Keeps residue on the soil
- RTK GPS for precision planting

Greg LaBarge, Ohio State University Extension

Developing 4R Nutrient Stewardship Certification

The Andersons

MABA

AGRIbusiness Council of INDIANA

MORRAL COMPANIES

Corn Marketing Program of Michigan
Michigan Corn Growers Association

CAP CONSERVATION action PROJECT

SOIL AND WATER RESOURCES
Ohio Department of Natural Resources

The Fertilizer Institute
Nourish, Replenish, Grow

The Nature Conservancy
Protecting nature. Preserving life.™

SOY OHIO
Ohio Soybean Council
www.soyohio.org

INDIANA CONSERVATION PARTNERSHIP

IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE

Ohio AgriBusiness Association

Ohio Federation of Soil and Water Conservation Districts

NRCS

Legacy Farmers Cooperative

OHIO FARM BUREAU

FARMERS ELEVATOR

WESTERN LAKE ERIE BASIN PARTNERSHIP

EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

Nester Ag LLC

SANDUSKY RIVER WATERSHED COALITION

MAEAP

MICHIGAN STATE UNIVERSITY

THE OHIO STATE UNIVERSITY

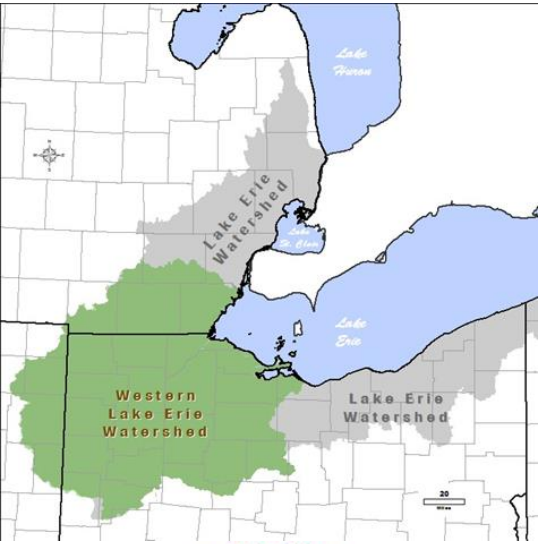
OhioCorn&Wheat Growers Association

AMERICAN SOCIETY OF AGRONOMY
CERTIFIED CROP ADVISER

4R Certification for Agri-retailers in the Lake Erie Watershed

Key criteria:

- Recommendations are consistent with the land-grant university, allowing for adaptive management.
- A certified professional reviews the nutrient recommendations made for the grower customers.
- **Source**: All sources of fertilizer are accounted for in the nutrient recommendation.
- **Rate**: Soil tests are less than four years old; application equipment is calibrated annually.
- **Time**: Avoids spreading on frozen or snow-covered fields; no broadcast prior to a predicted heavy rainfall.
- **Place**: Phosphorus is applied below the soil surface whenever possible; nutrient application setbacks are followed in sensitive areas.



http://4Rcertified.org/

4R – all over North America (and beyond)

- Western Lake Erie Watershed – 4R certification
- Illinois – KIC 2025 – 4R Code of Practice
- PA – 4R Alliance – outreach on best practices
- Chesapeake Bay – 4R NM definitions
- TFI – 4R Partners, 4R Advocates
- Canada – Farming 4R Future – Canadian Fertilizer Institute
- Alberta – Farming 4R Climate – nitrous oxide emissions
- Manitoba – 4R Designation – Lake Winnipeg
- PEI, Ontario – 4R demos

www.nutrientstewardship.com

www.farming4rfuture.ca

IPNI

Certified Crop Adviser Specialties

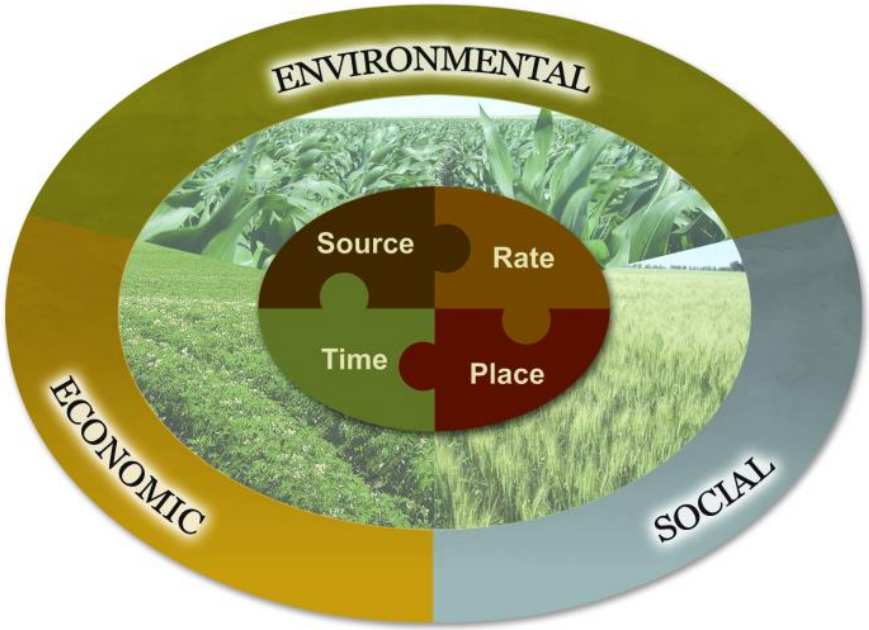
Proposed:

- **Sustainability Specialty**
  - Supported by United Soybean Board
    1. Communicating Sustainability
    2. Value Chain
    3. Resources & Environmental Stewardship
  - Modules and Exams coming in 2016
- **4R Nutrient Management Specialty**
  - involves CCA representatives from Illinois, Iowa, Minnesota, Wisconsin, and Michigan
  - basic knowledge standard; what USDA-NRCS and other view as needed to be certified in preparing Nutrient Management Plans

4R Research Fund
environmental, social, economic impacts

- Established by the fertilizer industry to support research on 4R sustainability impact across North America – aiming for $7M over 5 years.
- **Meta-analysis:** 5 projects, 2014-2015.
- **Measurement:** 4 projects, 2014-2019.
- For additional information: www.nutrientstewardship.com/funding

4R: “right” means sustainable



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Home > How To Make A Difference > Fertilizer Optimization

How to Make a Difference - Fertilizer optimization

CCA - THAT'S SOUND ADVICE TM

FARM & FOOD Care ONTARIO

“Building public trust in food and farming”

4R PLANT NUTRITION

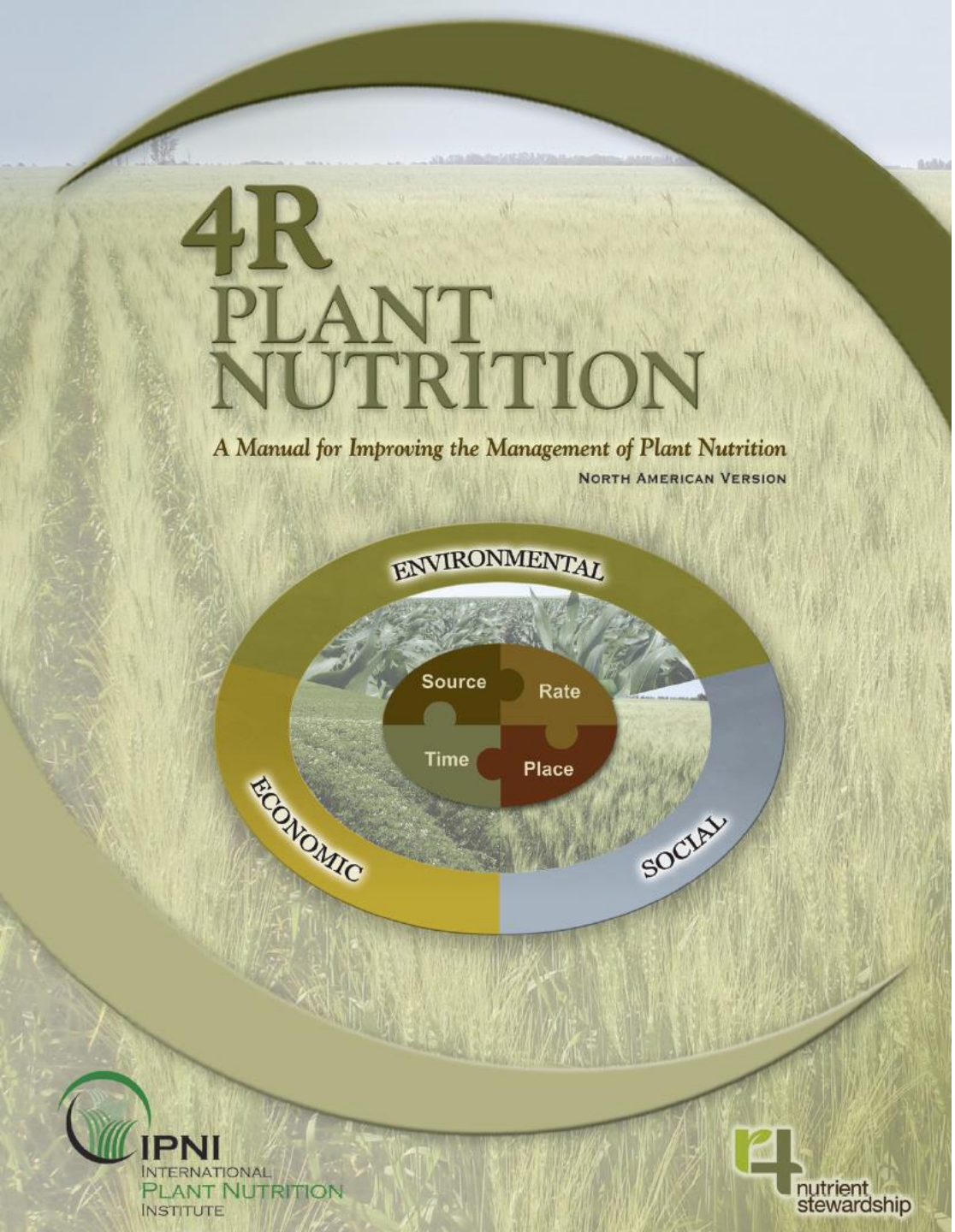
4 nutrient stewardship

Summary

4R Nutrient Stewardship:

Improving Yields and Water Quality

- Nutrient Use Efficiency
  - Intensify sustainably
- Nitrogen
  - Technologies to adapt your N management to weather need on-farm adaptive testing
- Phosphorus
  - Lake Erie: demands improvements in reducing nutrient loads while sustaining productivity
- Sustainability
  - Collaborating on the basis of 4R builds public trust



Thank You

nane.ipni.net

nutrient stewardship

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