Sylvite Agronomy Meeting 2013
London, Ontario
22 January 2013

IPNI
INTERNATIONAL
PLANT NUTRITION
INSTITUTE

The 4Rs and Great Lakes Water Quality

Tom Bruulsema, PhD, CCA
Director, Northeast Region, North America Program

Agrium Inc.


Arab Potash Company

Belarusian Potash Company

CF Industries Holdings, Inc.

Compass Minerals Specialty Fertilizers

Incitec Pivot

International Raw Materials LTD.

Intrepid Potash, Inc.

K+S KALI GmbH

The Mosaic Company

OCP S.A.

PotashCorp

Qatar Fertiliser Company (QAFCO)

Simplot

Sinofert Holdings Limited

SQM

Uralkali

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

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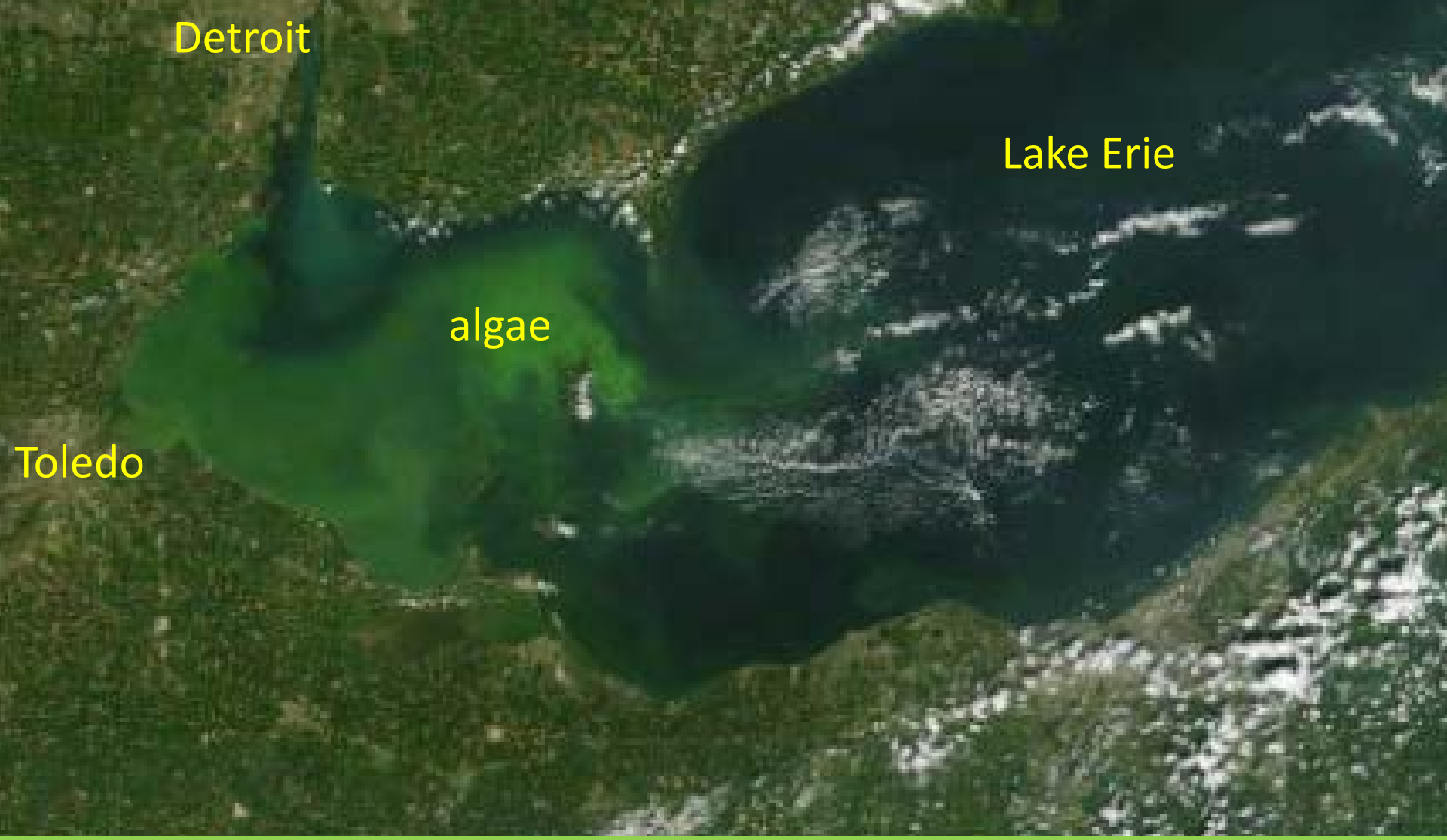
Ancaster, Ontario – 26 June 2009 – tilled corn

Ancaster, Ontario – 26 June 2009 – no-till soybeans

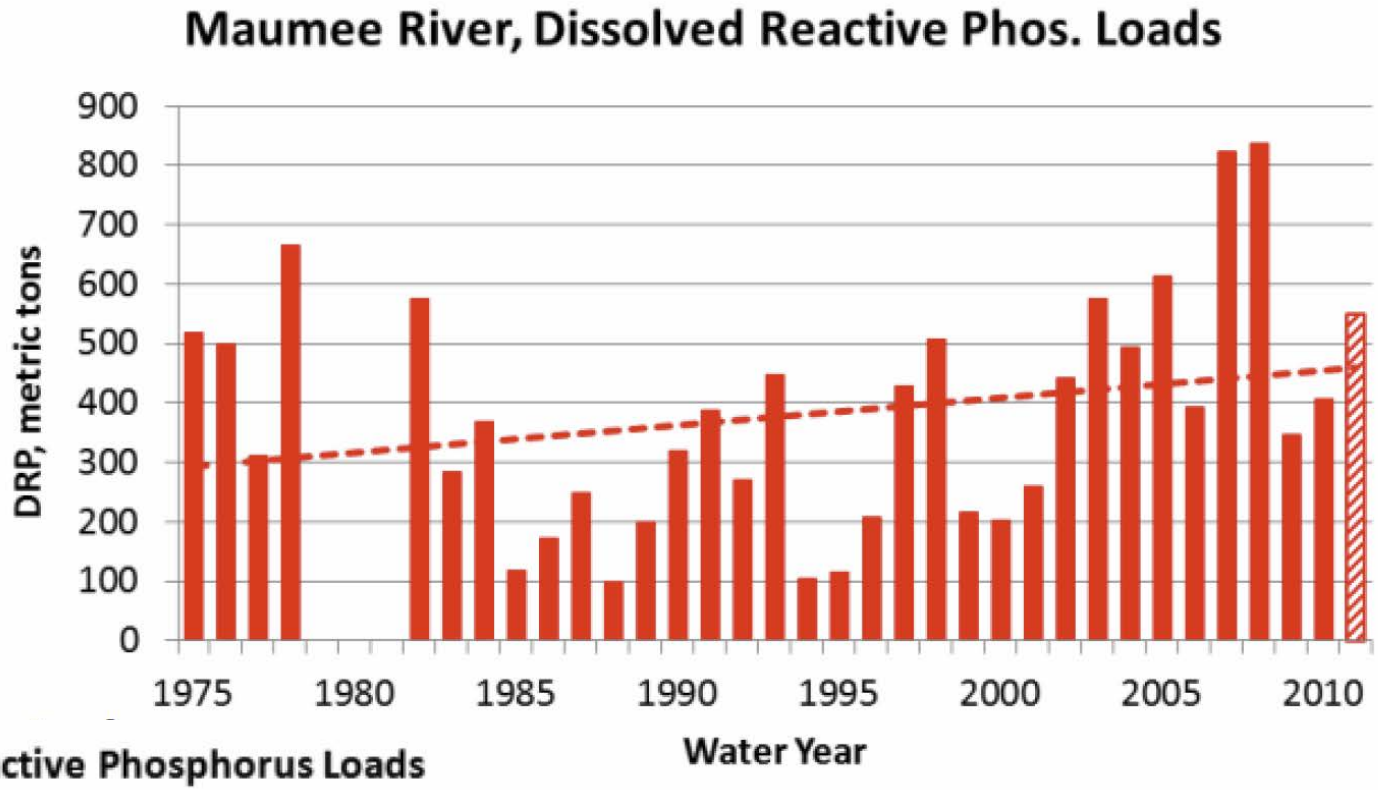
Outline

- **Lake Erie and Dissolved P**
- **Sustainability and 4R Nutrient Stewardship**
- **4R N and P management**
- **4R Educational initiatives**
- *Slides: available at http://nane.ipni.net*

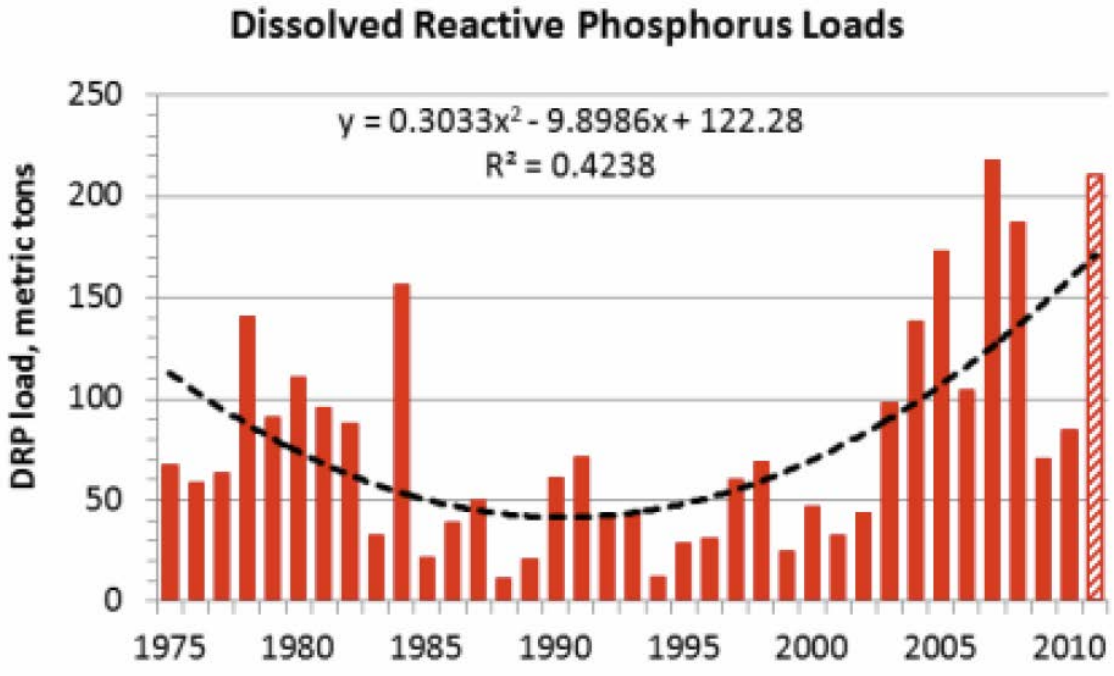


An aerial photo of a Lake Erie algal bloom on August 19, 2011.

Source: www.glerl.noaa.gov/res/Centers/HABS/western_lake_erie



Sandusky River



Baker, 2011. Heidelberg University

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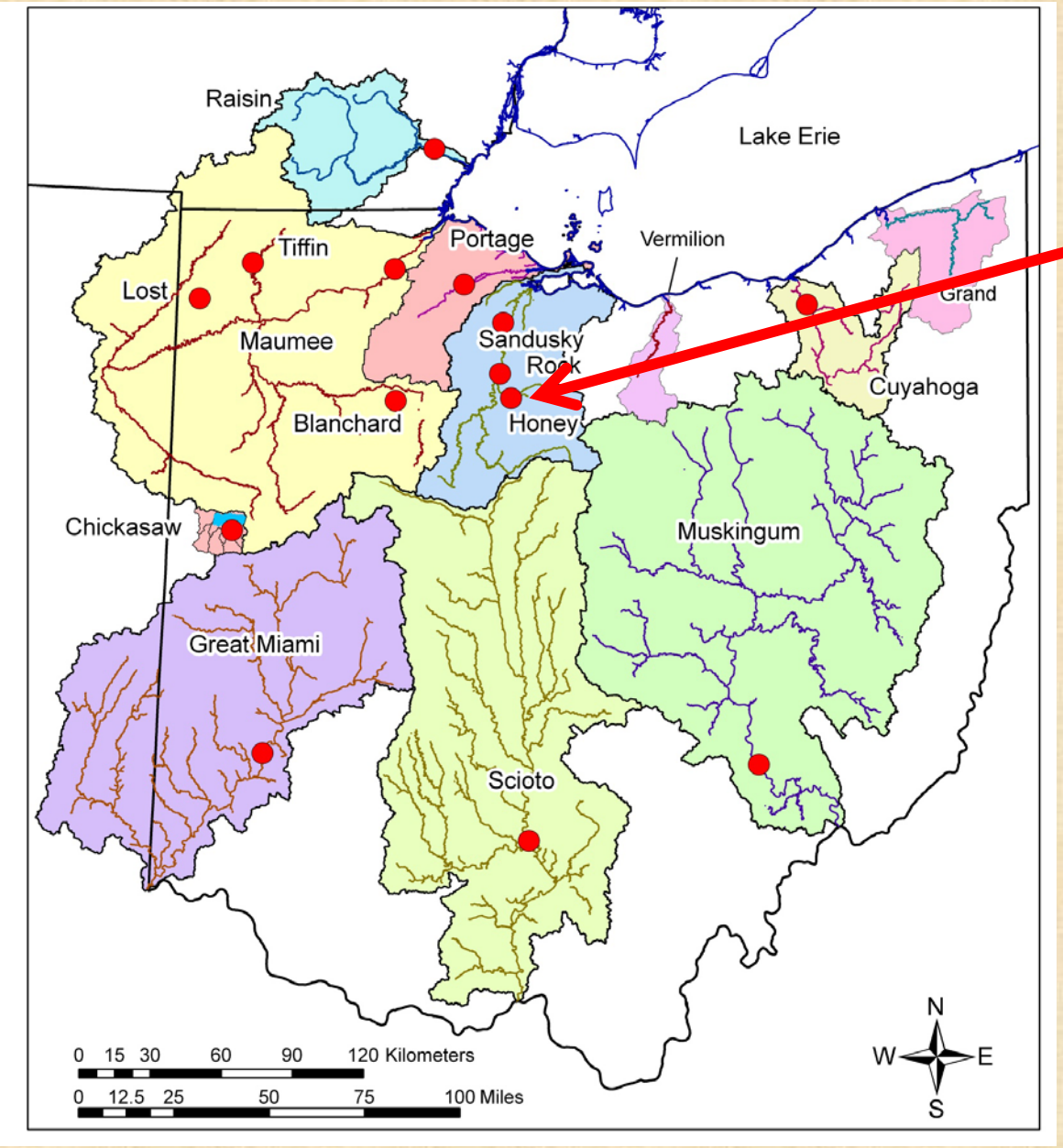
The Heidelberg University Tributary Loading Program



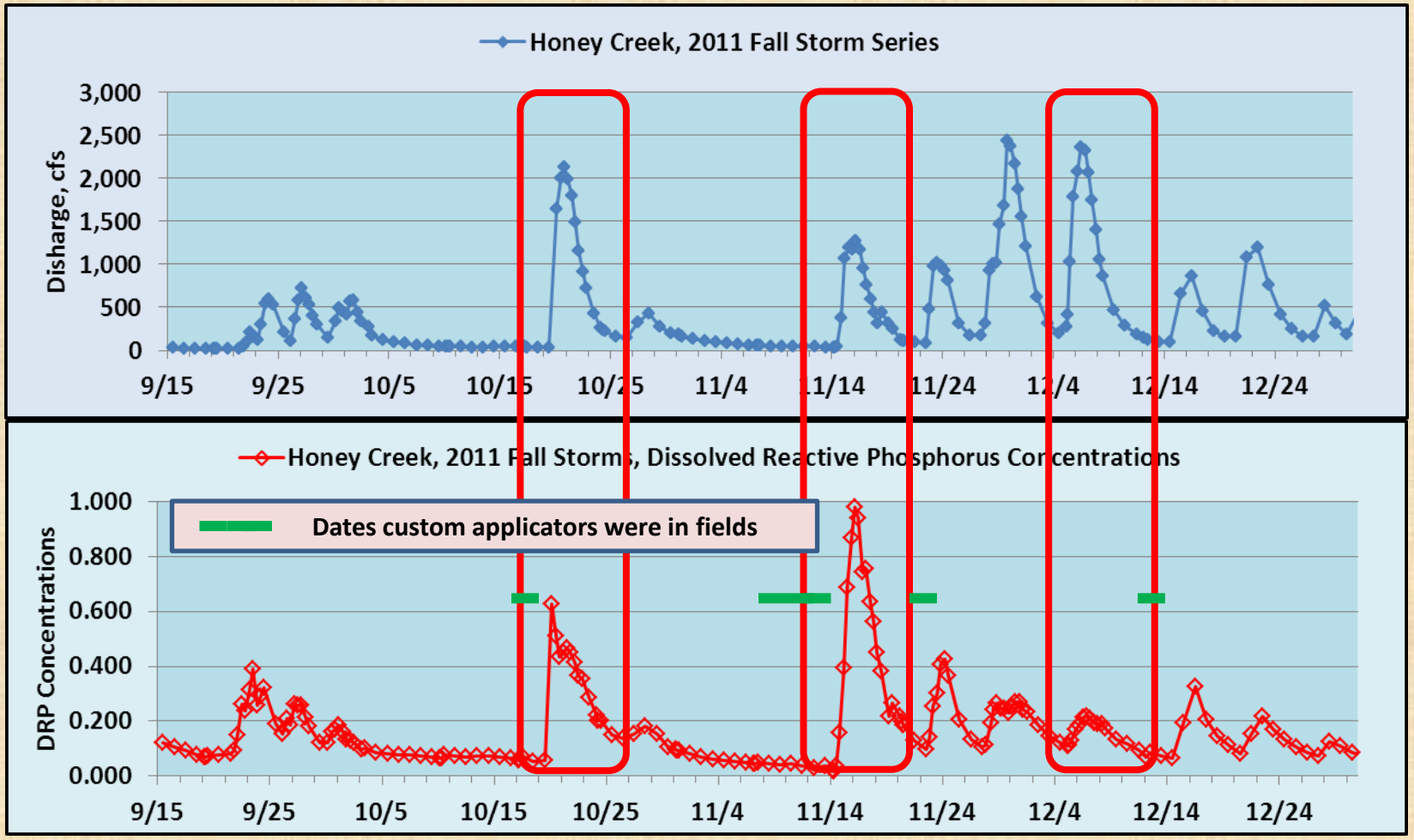
Focus on the Honey Creek Watershed that drains into the Sandusky River.

95,000 acres

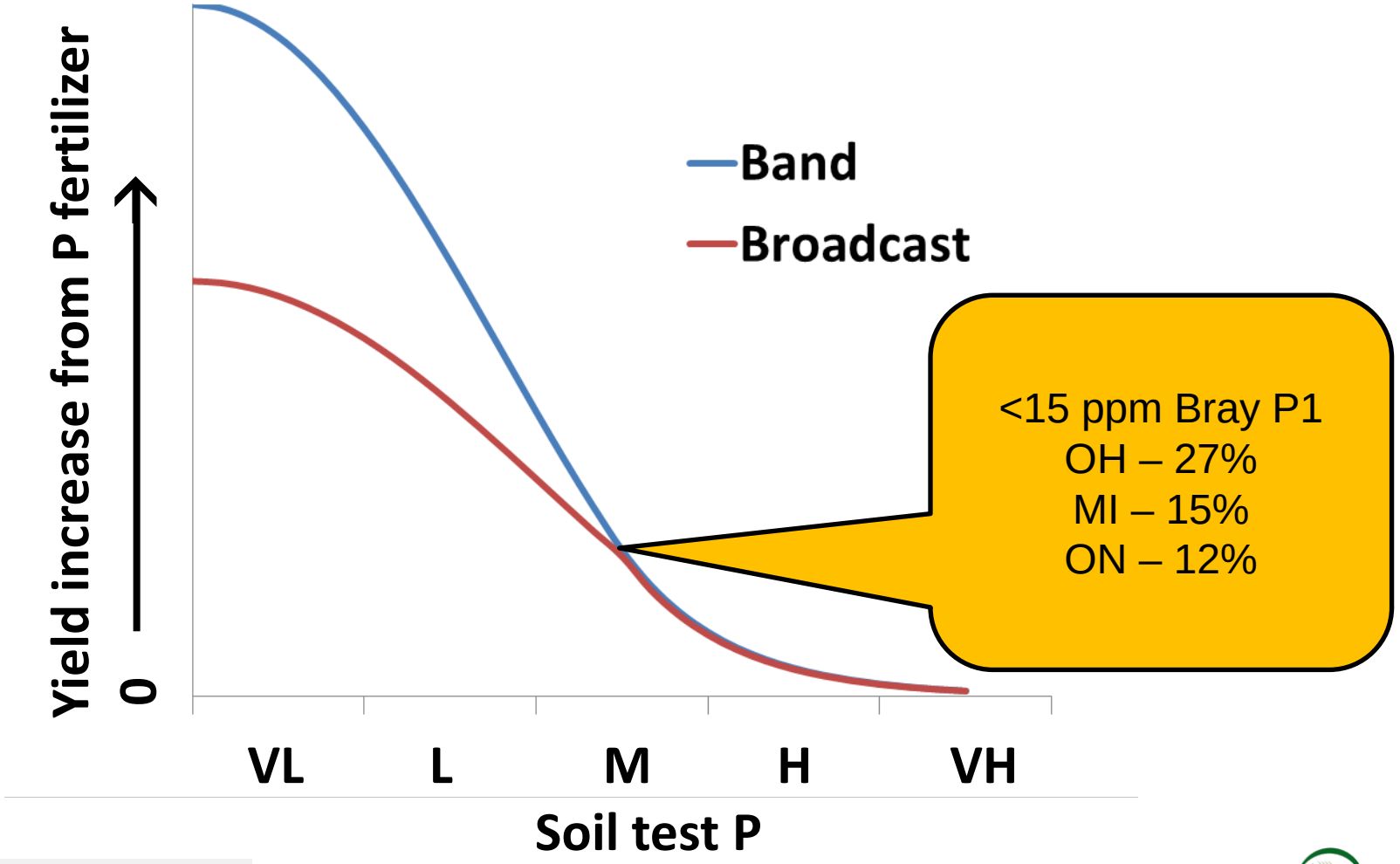
~80% row crops

Dr. David Baker

Fall 2011 storms, Honey Creek, Ohio



Idealized effect of placement on crop response

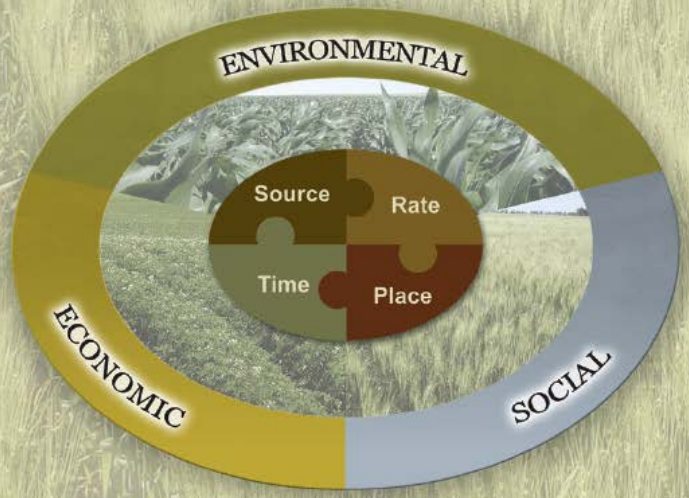


Randall and Hoeft, 1988

4R PLANT NUTRITION

A Manual for Improving the Management of Plant Nutrition

NORTH AMERICAN VERSION



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4R nutrient stewardship

http://nane.ipni.net

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Goals of Sustainable Agriculture

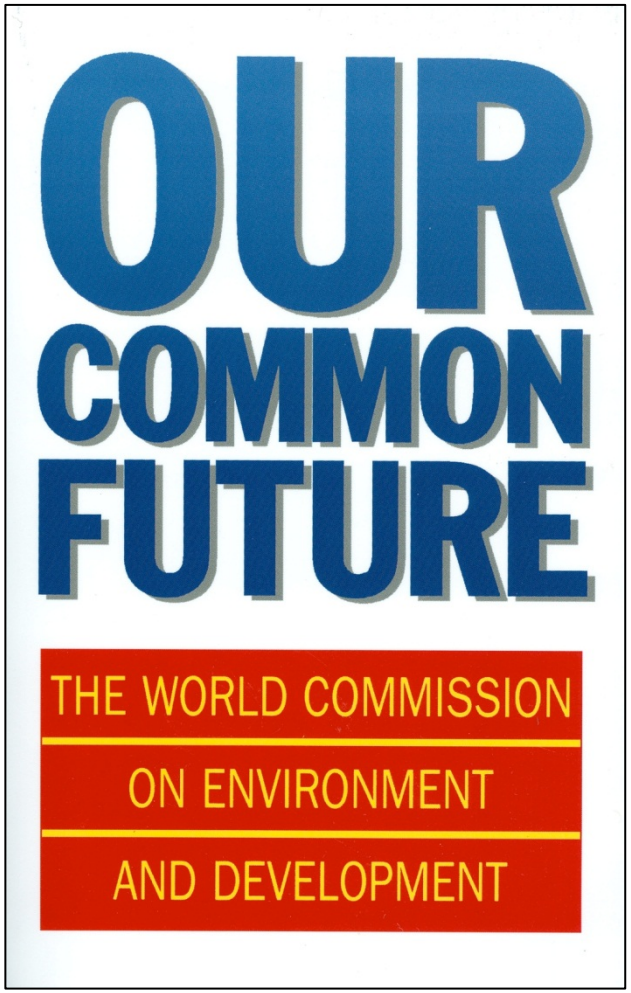
4R Plant Nutrition Manual

Chapter 1

4R PLANT NUTRITION

Brundtland report

- *Our Common Future* (1987) addressed concerns "about the accelerating deterioration of the **human environment** and **natural resources** and the consequences of that deterioration for **economic** and **social development**."
- This report provided the basis for sustainable agriculture.



Source: Advisory Panel on Food Security, Agriculture, Forestry, and Environment. World Commission on Environment and Development. 1987.

Sustainability Initiatives Abound in 2012

PEPSICO

Home | Company | Purpose | Brands | Inves

Performance with Purpose

Home » Purpose » Environmental Sustainability » Agriculture

PURPOSE

Agriculture

THE SUSTAINABILITY CONSORTIUM

4R PLANT NUTRITION

Field to Market

Field To Market: The Keystone Alliance for Sustainable Agriculture

Field To Market is a diverse alliance working to create opportunities across the agricultural s… productivity, environmer… group provides collabor… wide dialogue, grounde… technology choices.

Fieldprint Calculator

The Fieldprint Calculator is an educational too… designed to help you assess how some of your operational decisions affect overall sustainability performance. The

Environmental Sustainability

Sustainable Agriculture

Definition: Accommodating the growing demand for production without compromising the natural **resources** upon which agriculture depends.

The concept of sustainability is multi-dimensional. It applies to

- **Social**
- **Economic**
- **Environmental**

dimensions simultaneously.

nutrient stewardship

The 4R Nutrient Stewardship Concept

4R Plant Nutrition Manual

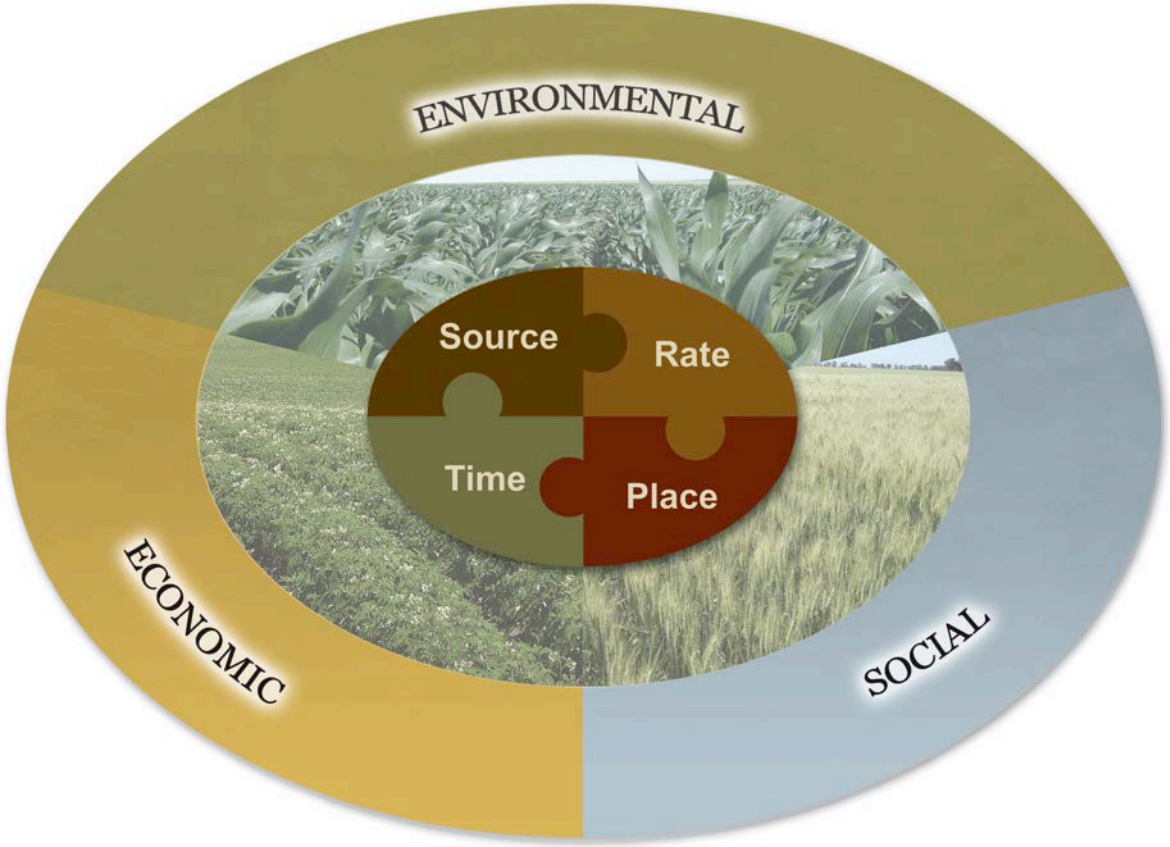
Chapter 2

4R PLANT NUTRITION

Source, rate, time, and place describe any nutrient application

Right means Sustainable

- Right source, rate, time, and place
- Outcomes valued by stakeholders



Stakeholders have a say on performance indicators

- Stakeholders define goals
- Indicators relate to goals
- Producers choose practices

nutrient stewardship

Producers choose practices

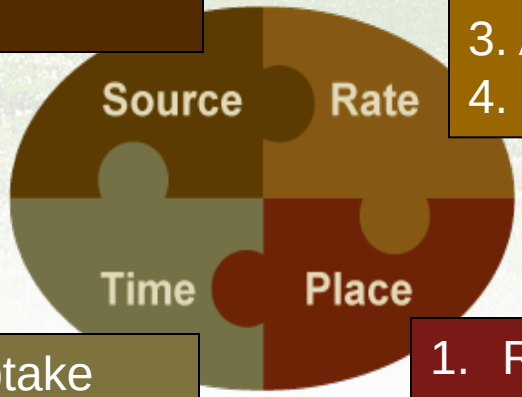
- Practices selected to suit local site-specific soil, weather, and crop conditions
- Conditions may change even on the day of application
- Local decisions preferred

nutrient stewardship

The basic scientific principles of managing crop nutrients are universal

1. Supply in plant available forms
2. Suit soil properties
3. Recognize synergisms among elements
4. Blend compatibility

1. Appropriately assess soil nutrient supply
2. Assess all available indigenous nutrient sources
3. Assess plant demand
4. Predict fertilizer use efficiency

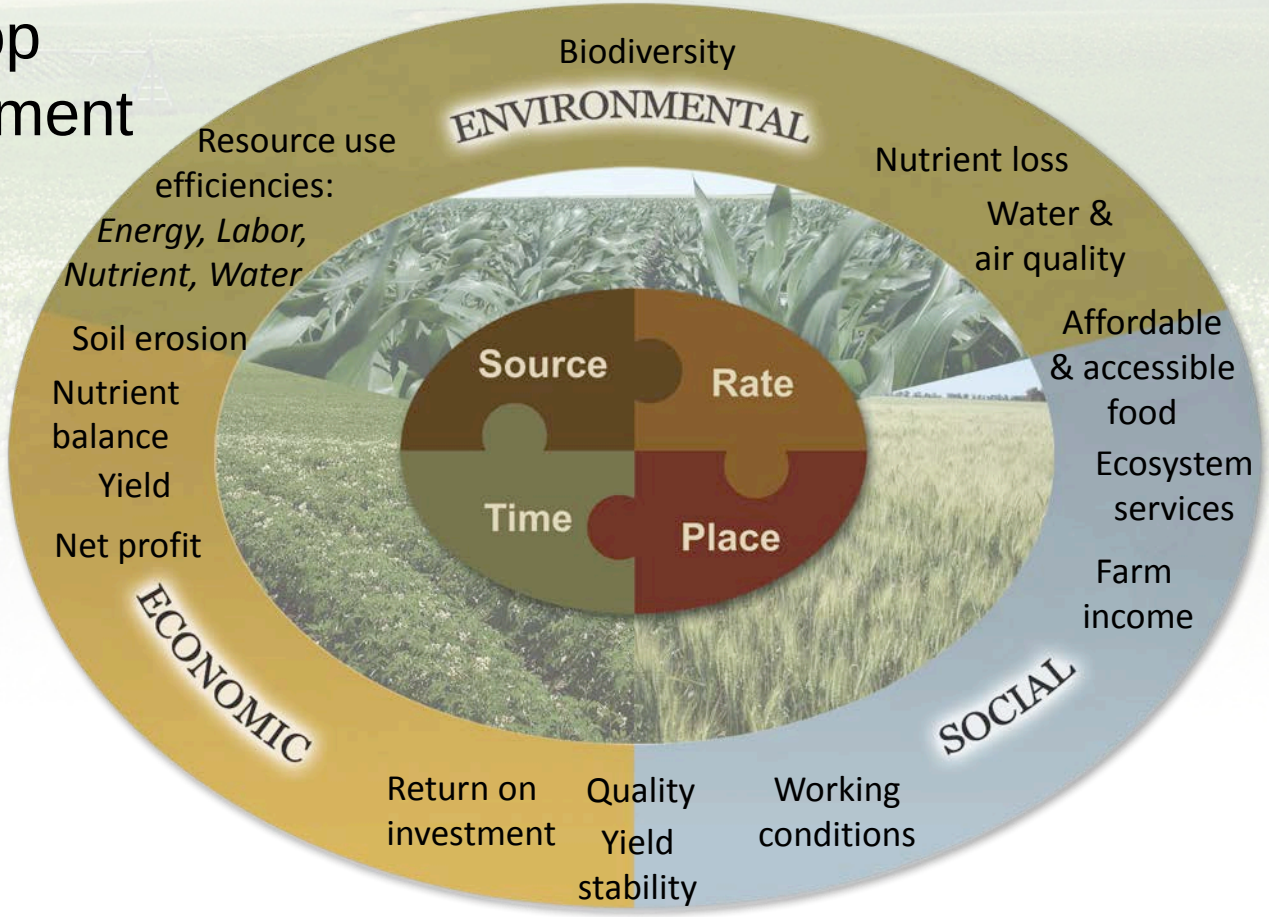


1. Assess timing of crop uptake
2. Assess dynamics of soil nutrient supply
3. Recognize timing of weather factors
4. Evaluate logistics of operations

1. Recognize root-soil dynamics
2. Manage spatial variability
3. Fit needs of tillage system
4. Limit potential off-field transport

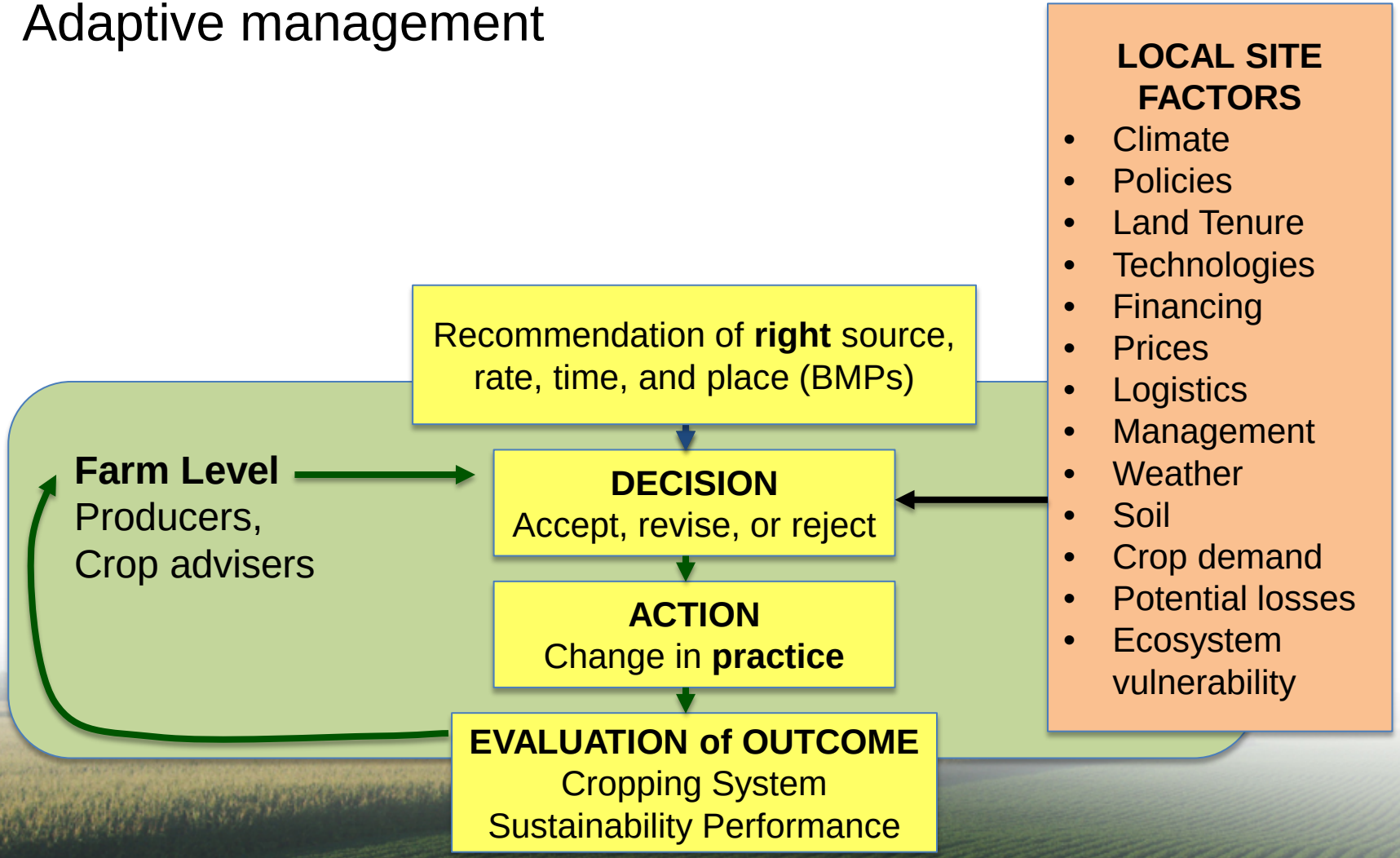
The 4Rs influence many performance indicators

- social, economic and environmental performance
- influenced by crop and soil management as well
- whole system outcomes



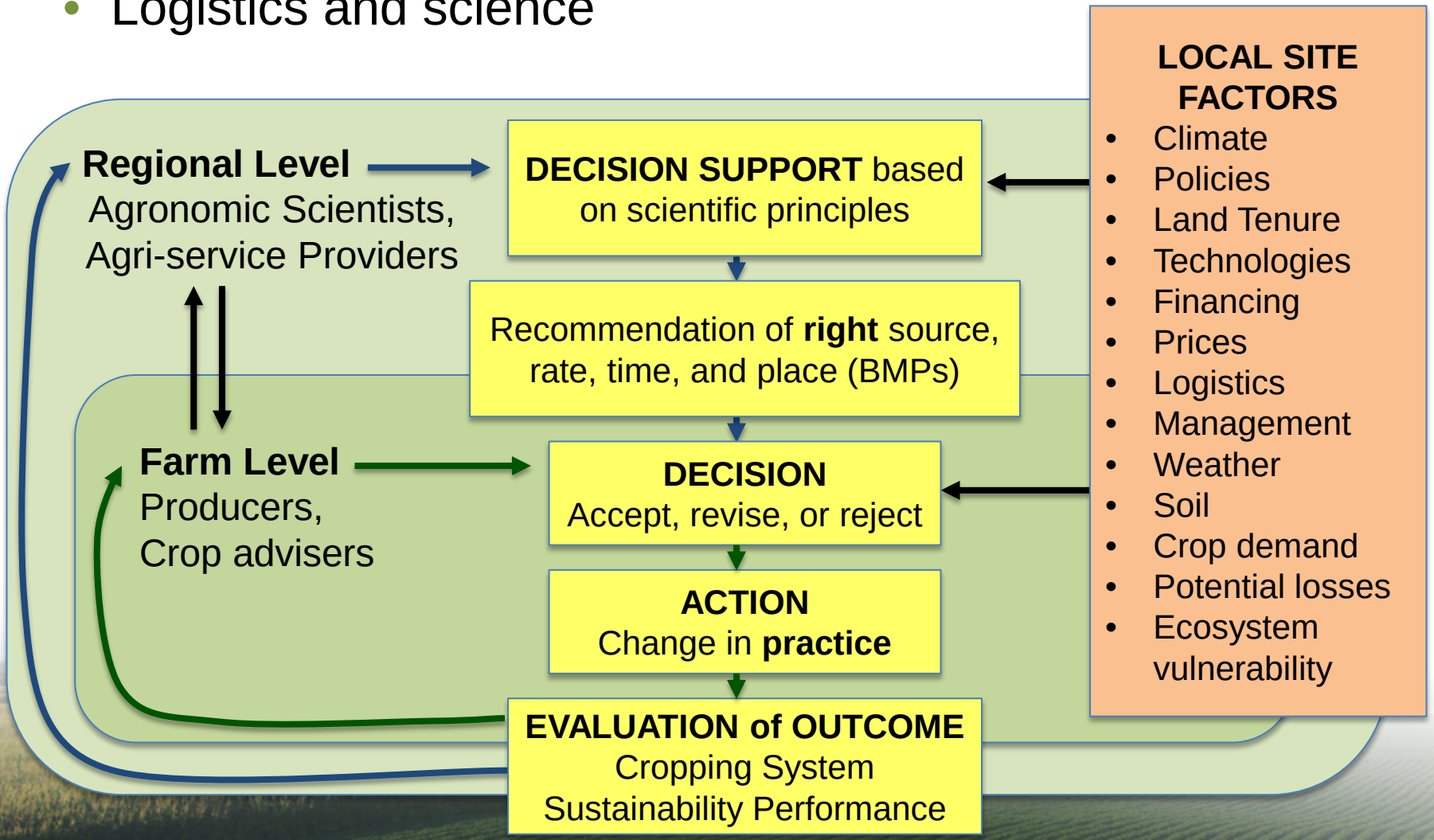
BMP adoption and evaluation – farm level

- Adaptive management



BMP adoption and evaluation – regional level

- Logistics and science



4R Nutrient Stewardship plan - principles

- For each farm:
  - sustainability goals
  - performance indicators
- For each field:
  - Management information (proprietary)
    - Soil test data
    - Nutrient application data (SRTP for each application)
    - Nutrient balance
  - Performance indicator data (public)
    - Yield? Nutrient balance?
    - Crop Quality? Working conditions? Water quality monitoring?

4R N and P management

4Rs for higher N use efficiency

- **WEATHER:** crop demand, soil supply, losses
- Source:
  - Soluble, controlled-release, inhibitors – “enhanced efficiency”
  - Account for N from manures, irrigation water
- Rate:
  - Ontario Corn N Calculator (gocorn.net): 600 site-years, 6 factors
  - Pre-sidedress soil nitrate test
  - Adapt-N (Cornell) – crop model based on weather up to sidedress
- Time: preplant, sidedress, split
- Place: avoid leaving urea on the soil surface

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Ontario Crop Nutrient Removal

	2011			2012		
	Corn	**Soybeans**	**Wheat**	**Corn**	**Soybeans**	**Wheat**
Yield (bu/A)	151	45	73	153	46	76
Removal (lb/A)						
N	**101**	**145**	**85**	**102**	**150**	**88**
P_2O_5	**61**	**33**	**35**	**61**	**34**	**36**
K_2O	**38**	**53**	**21**	**38**	**54**	**22**
Harvested Acres	2,000,027	2,454,939	1,214,991	2,210,062	2,584,913	908,834
Removal (tons)						
N	**101,400**	**178,000**	**51,400**	**113,300**	**193,700**	**40,000**
P_2O_5	**60,600**	**40,000**	**21,300**	**67,600**	**43,500**	**16,500**
K_2O	**37,800**	**64,600**	**12,800**	**42,300**	**70,300**	**10,000**

NPK removal for corn and soybeans up 10% over 2011

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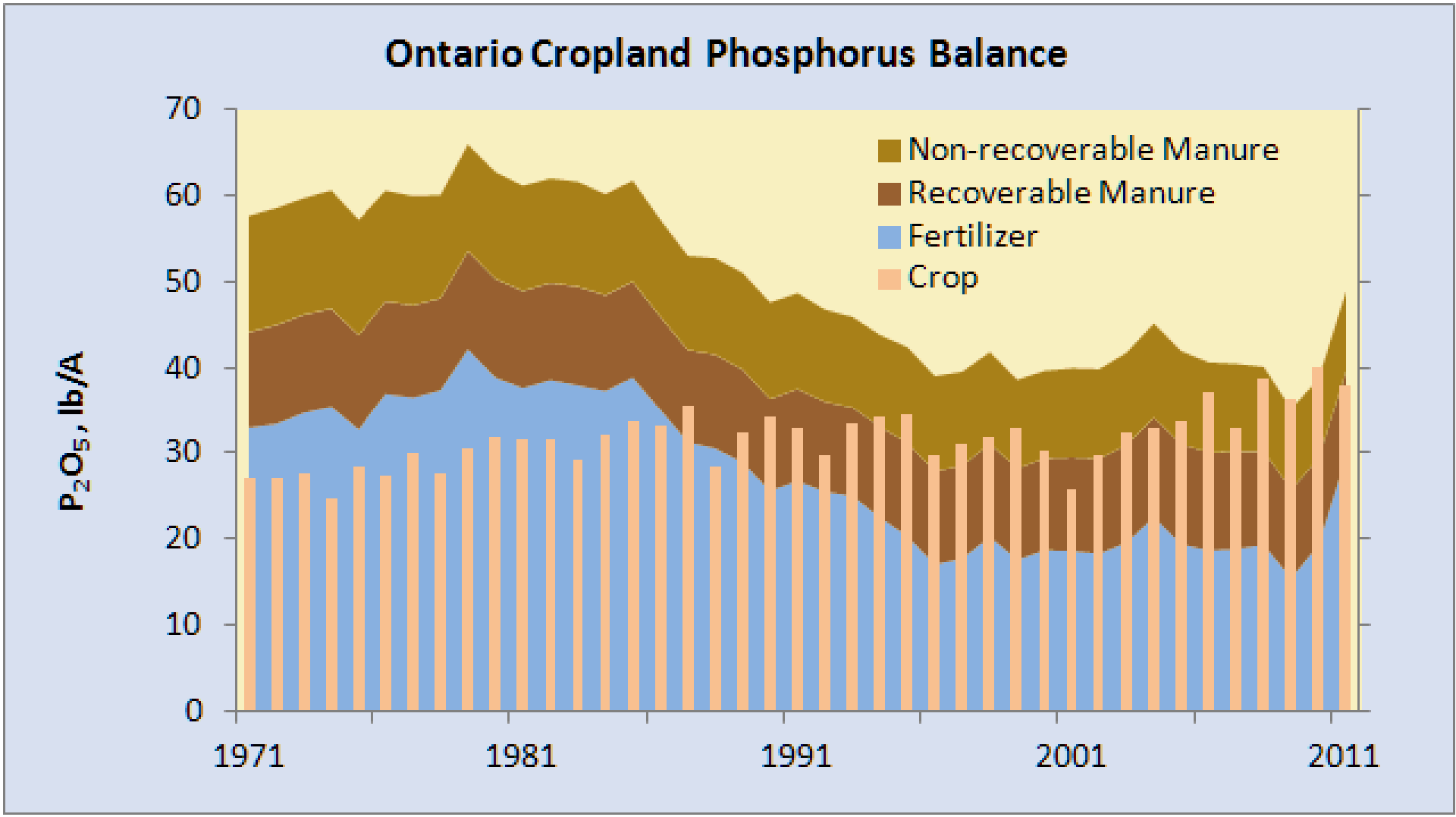
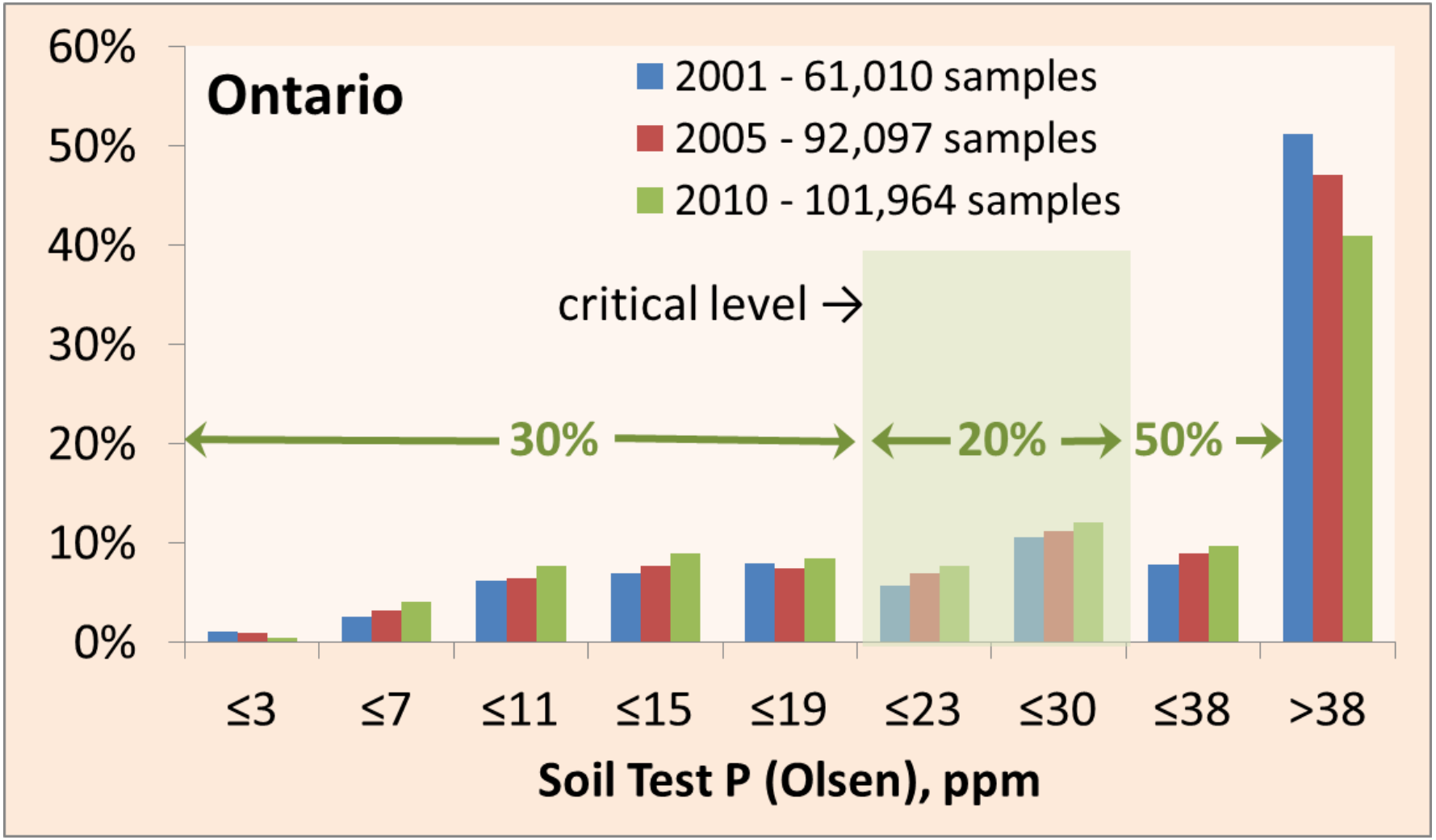
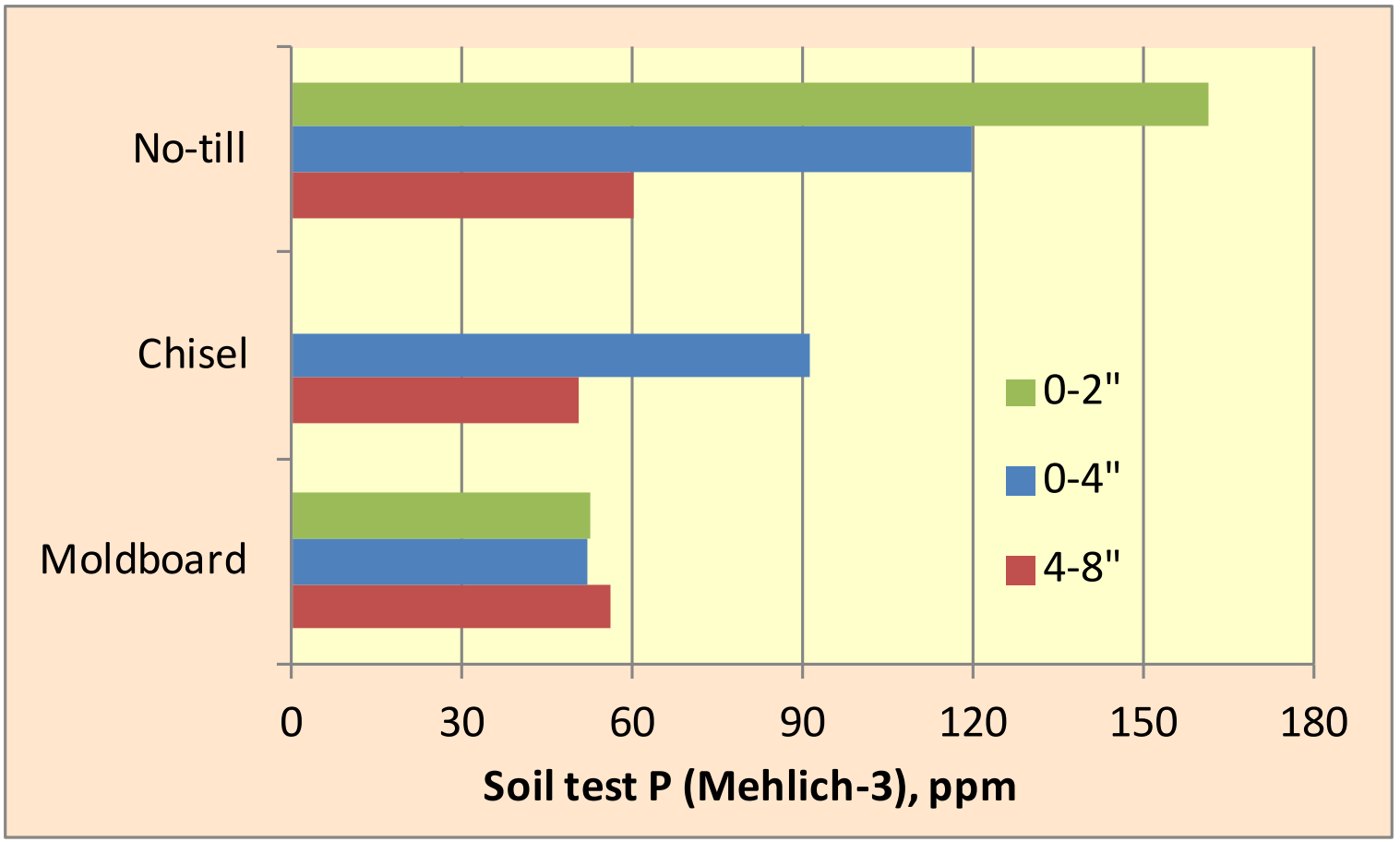

Ontario Cropland Phosphorus Balance
70
60
50
40
30
20
10
0
P_2O_5, lb/A
1971
1981
1991
2001
2011
Non-recoverable Manure
Recoverable Manure
Fertilizer
Crop

Soil test P distribution, 2001-2010

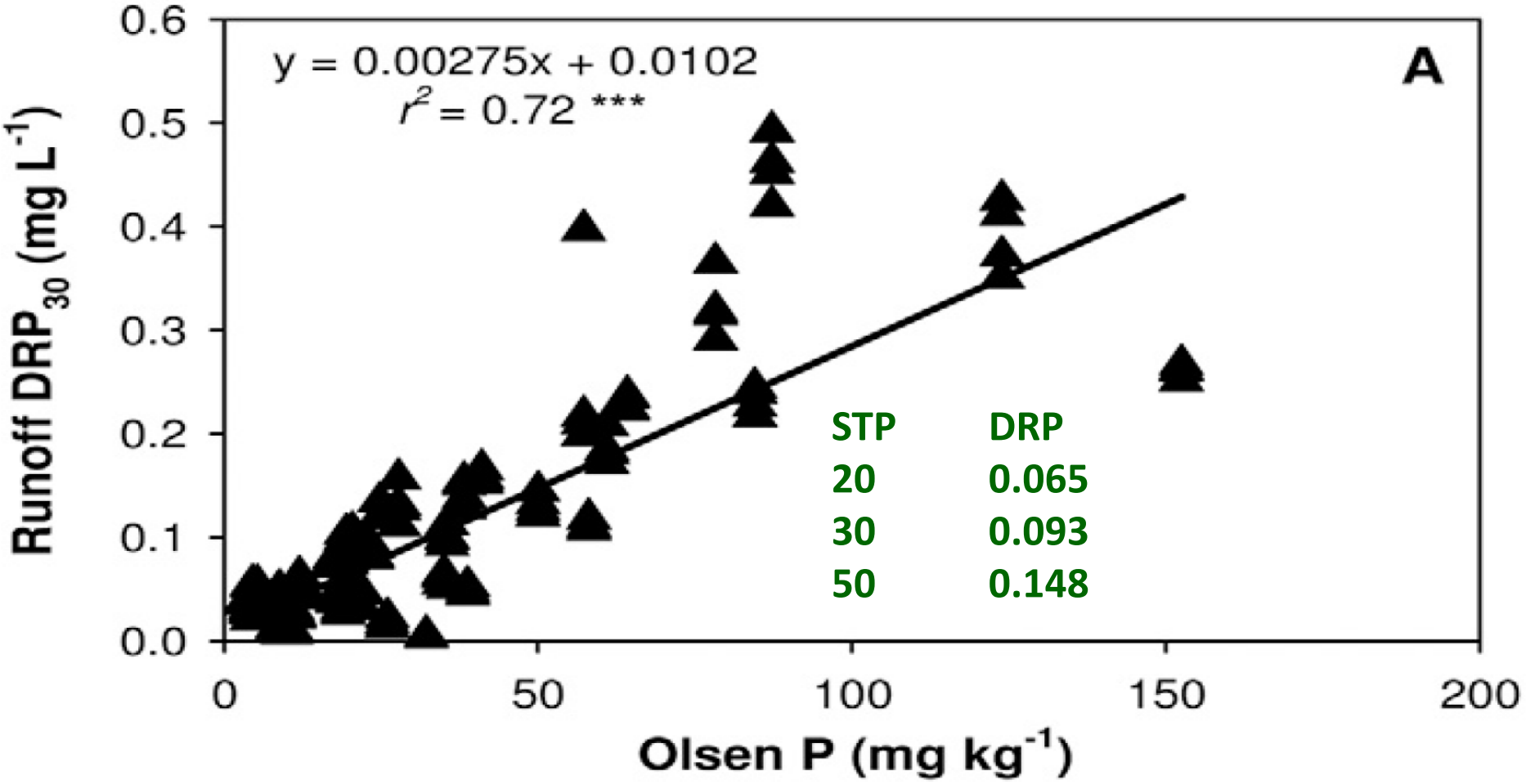


Soil test P stratifies when moldboard plowing stops



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.

Soil test P and runoff P in Ontario

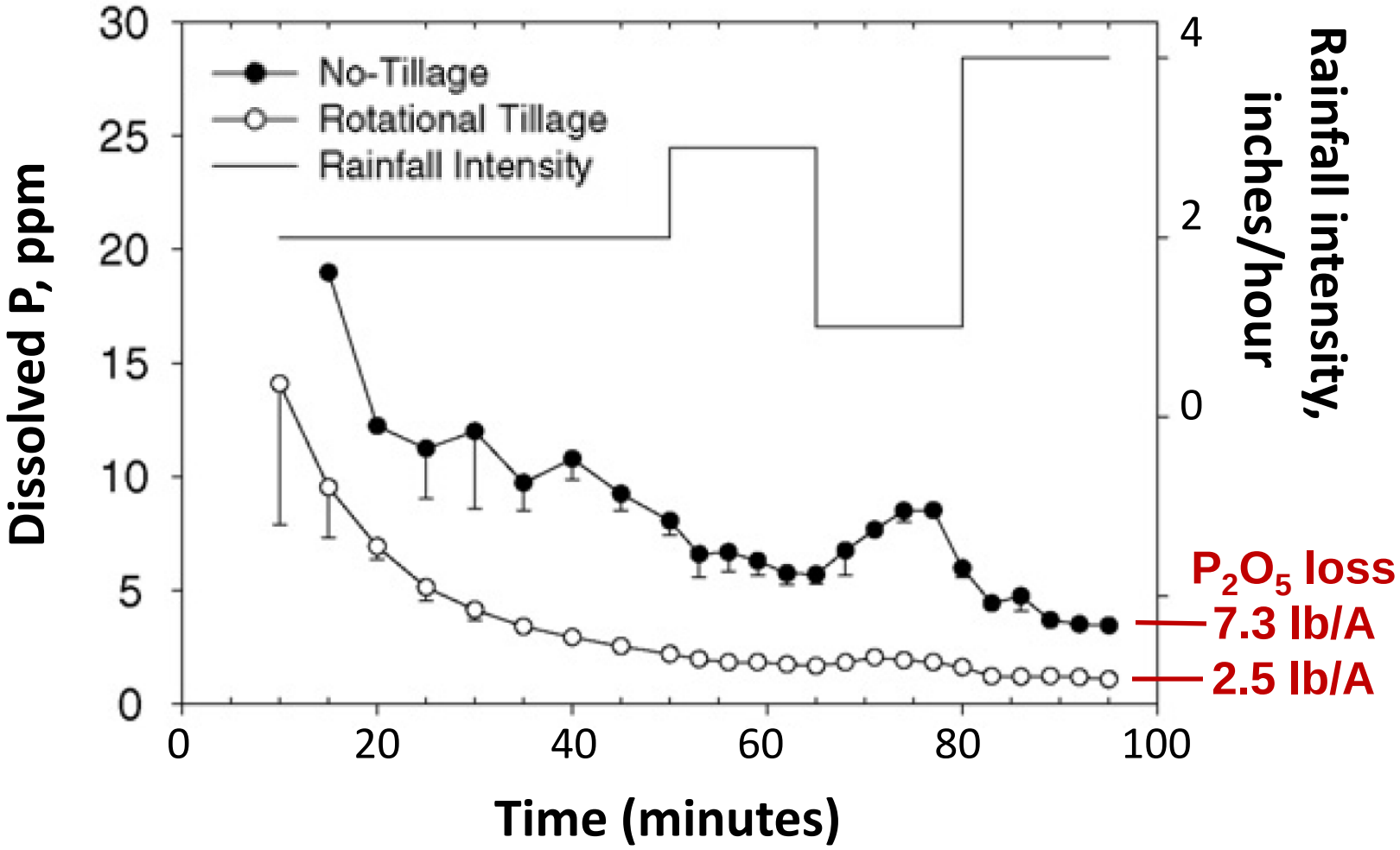


Six soil series, ten sites each, ranging in soil test P.
Standardized runoff boxes, rainfall applied at 3” per hour for 30 minutes runoff.

Wang et al., 2010. J. Environ. Qual. 39:1771–1781

Rotational tillage & dissolved P – Waterloo, IN

one day after 0-46-0 fertilizer surface applied @ 100 lb/A P_2O_5



15-year no-till sites, corn-soybean rotation. Tillage 12 April with "finisher" chisel plow to 6" depth. Residue cover 57% for NT and 20% for RT. Rainfall applied 22 June to 2 July. *Smith et al. 2007. Soil & Tillage Research 95:11–18*

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Practice	Advantages	Limitations
S – MAP or DAP R – rotation removal T – fall P – broadcast	Minimal soil compaction Allows timely planting in spring Low-cost fertilizer form Low cost of application	Risk of elevated P in runoff in late fall and winter Low N use efficiency
S – MAP or DAP R – rotation removal T – spring P – broadcast	Minimal soil compaction Better N use efficiency Low-cost fertilizer form Low cost of application	Risk of elevated P in spring runoff before incorporation Potential to delay planting Retailer spring delivery capacity
S – MAP or fluid APP R – one crop removal T – spring P – 2” x 2” band	Low risk of elevated P in runoff Most efficient use of N Less soil P stratification	Cost and practicality Potential to delay planting Retailer delivery capacity Cost of fluid versus granular P
S – MAP or DAP R – rotation removal T – fall P – banded in zone	Low risk of elevated P in runoff Maintain some residue cover Allows timely planting in spring Less soil P stratification	Cost of RTK GPS guidance Cost of new equipment More time required than broadcast
S – fluid APP P – point injection	As above	As above, plus cost of fluid versus granular P

Summary

- Sustainability requires communication of responsible management.
- 4R Nutrient Stewardship provides a framework to improve sustainability
- 4R management of N requires attention to weather's impacts on
  - Crop demand
  - Soil supply
  - Losses
- 4R management of P requires a focus on Right Place
  - In the soil, not on the soil

4R nutrient stewardship

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4R Education and Outreach

- IPNI
- American Society of Agronomy
- Ohio [Michigan, Pennsylvania, Illinois]
- Canada – Farming 4R Future
- TFI 4R Advocate

IPNI INSIGHTS
INTERNATIONAL PLANT NUTRITION INSTITUTE

December 2012

Reducing Loss of Fertilizer Phosphorus to Lake Erie with the 4Rs

Algal blooms in Lake Erie have been getting worse in the past few years. Phosphorus (P) has often been considered the nutrient controlling such blooms. The loads of dissolved P in the rivers draining into Lake Erie vary greatly year-to-year, but higher loads have become more frequent in recent years than in the mid-1990s. Agriculture is one of several sources of dissolved P.

This article outlines how crop producers in the Lake Erie watershed can reduce losses of P by adopting a 4R Nutrient Stewardship approach to guide their fertilizer application practices.

Background

Much of the cropland of the Lake Erie watershed is found in Ohio, with smaller areas in Indiana, Michigan and Ontario

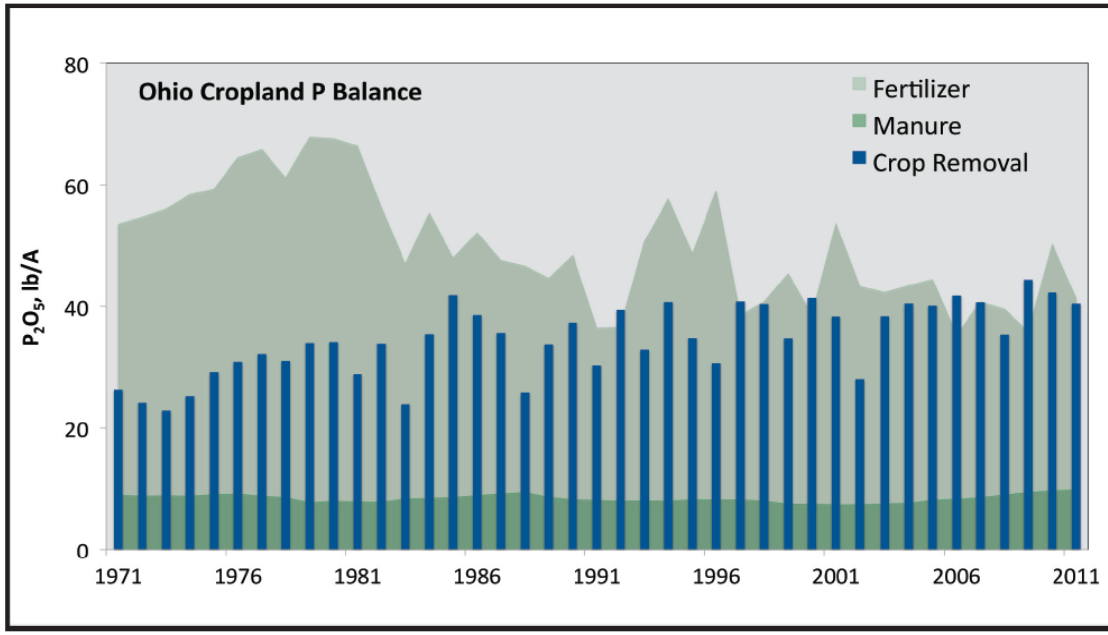
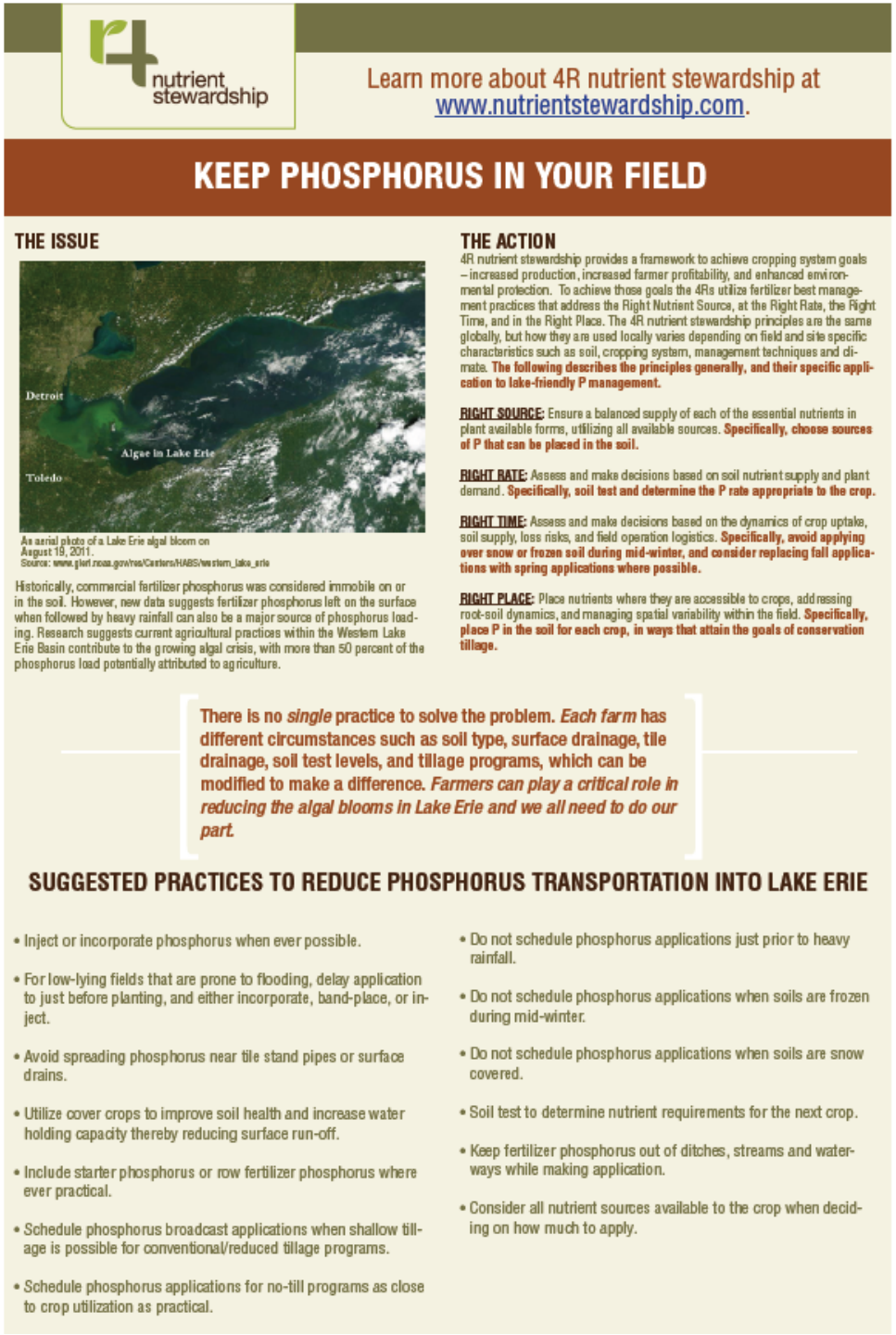


Figure 2. Phosphorus balance trend over time for Ohio cropland. *2011 fertilizer estimated.

Ohio – Industry Involvement

- Participated in state meetings
- Provided outreach at expos and meetings
- Actively encouraging producers to use the 4Rs
- Supporting research needs
- Developing 4R service provider recognition program



4R nutrient stewardship

Learn more about 4R nutrient stewardship at www.nutrientstewardship.com.

KEEP PHOSPHORUS IN YOUR FIELD

THE ISSUE

An aerial photo of a Lake Erie algal bloom on August 19, 2011.
Source: www.glerl.noaa.gov/res/Centers/HABS/western_lake_erie

Historically, commercial fertilizer phosphorus was considered immobile on or in the soil. However, new data suggests fertilizer phosphorus left on the surface when followed by heavy rainfall can also be a major source of phosphorus loading. Research suggests current agricultural practices within the Western Lake Erie Basin contribute to the growing algal crisis, with more than 50 percent of the phosphorus load potentially attributed to agriculture.

THE ACTION

4R nutrient stewardship provides a framework to achieve cropping system goals – increased production, increased farmer profitability, and enhanced environmental protection. To achieve those goals the 4Rs utilize fertilizer best management practices that address the Right Nutrient Source, at the Right Rate, the Right Time, and in the Right Place. The 4R nutrient stewardship principles are the same globally, but how they are used locally varies depending on field and site specific characteristics such as soil, cropping system, management techniques and climate. **The following describes the principles generally, and their specific application to lake-friendly P management.**

RIGHT SOURCE: Ensure a balanced supply of each of the essential nutrients in plant available forms, utilizing all available sources. **Specifically, choose sources of P that can be placed in the soil.**

RIGHT RATE: Assess and make decisions based on soil nutrient supply and plant demand. **Specifically, soil test and determine the P rate appropriate to the crop.**

RIGHT TIME: Assess and make decisions based on the dynamics of crop uptake, soil supply, loss risks, and field operation logistics. **Specifically, avoid applying over snow or frozen soil during mid-winter, and consider replacing fall applications with spring applications where possible.**

RIGHT PLACE: Place nutrients where they are accessible to crops, addressing root-soil dynamics, and managing spatial variability within the field. **Specifically, place P in the soil for each crop, in ways that attain the goals of conservation tillage.**

There is no *single* practice to solve the problem. *Each farm* has different circumstances such as soil type, surface drainage, tile drainage, soil test levels, and tillage programs, which can be modified to make a difference. *Farmers can play a critical role in reducing the algal blooms in Lake Erie and we all need to do our part.*

SUGGESTED PRACTICES TO REDUCE PHOSPHORUS TRANSPORTATION INTO LAKE ERIE

- Inject or incorporate phosphorus when ever possible.
- For low-lying fields that are prone to flooding, delay application to just before planting, and either incorporate, band-place, or inject.
- Avoid spreading phosphorus near tile stand pipes or surface drains.
- Utilize cover crops to improve soil health and increase water holding capacity thereby reducing surface run-off.
- Include starter phosphorus or row fertilizer phosphorus where ever practical.
- Schedule phosphorus broadcast applications when shallow tillage is possible for conventional/reduced tillage programs.
- Schedule phosphorus applications for no-till programs as close to crop utilization as practical.
- Do not schedule phosphorus applications just prior to heavy rainfall.
- Do not schedule phosphorus applications when soils are frozen during mid-winter.
- Do not schedule phosphorus applications when soils are snow covered.
- Soil test to determine nutrient requirements for the next crop.
- Keep fertilizer phosphorus out of ditches, streams and waterways while making application.
- Consider all nutrient sources available to the crop when deciding on how much to apply.

Ohio – 4R as Foundation

- Summer 2011 – Fertilizer community initiates engagement
- October 2011 – adoption of 4Rs by OH Dept. of Ag, OH EPA, OH DNR
- March 2012 – final report naming 4Rs Foundation of Nutrient Management
- June 2012 – Healthy Lake Erie Fund, $3M – to help implement 4Rs

The 4R Approach to Soil and Water Quality

An Online Course from the American Society of Agronomy

Orientation Date: January 17, 2013

Class Dates: January 24 - March 14, 2013

Dates are subject to change

Class Time: 7:00 pm to 9:00 pm Eastern/6:00 pm to 8:00 pm Central/5:00 pm to 7:00 pm Mountain/4:00 pm to 6:00 pm Pacific

Register Now

Registration deadline is Friday, January 11, 2013

nutrient stewardship

Farming 4R Watershed

AgriINNOVATIONS: Supporting farmers and communities with practical tools to implement Beneficial Management Practices that protect water quality and grow agriculture.

FARMING 4R FUTURE
Stewardship Today, to Feed Tomorrow

4R Nutrient Stewardship encompasses:

Right Source | Right Rate | Right Time | Right Place

AgriINNOVATIONS

Canadian Fertilizer Institute
Institut Canadien des Engrais

Ontario Centres of Excellence
Where Next Happens

OFA

Grand River Conservation Authority

the water INSTITUTE

Region of Waterloo

farming4Rfuture.ca

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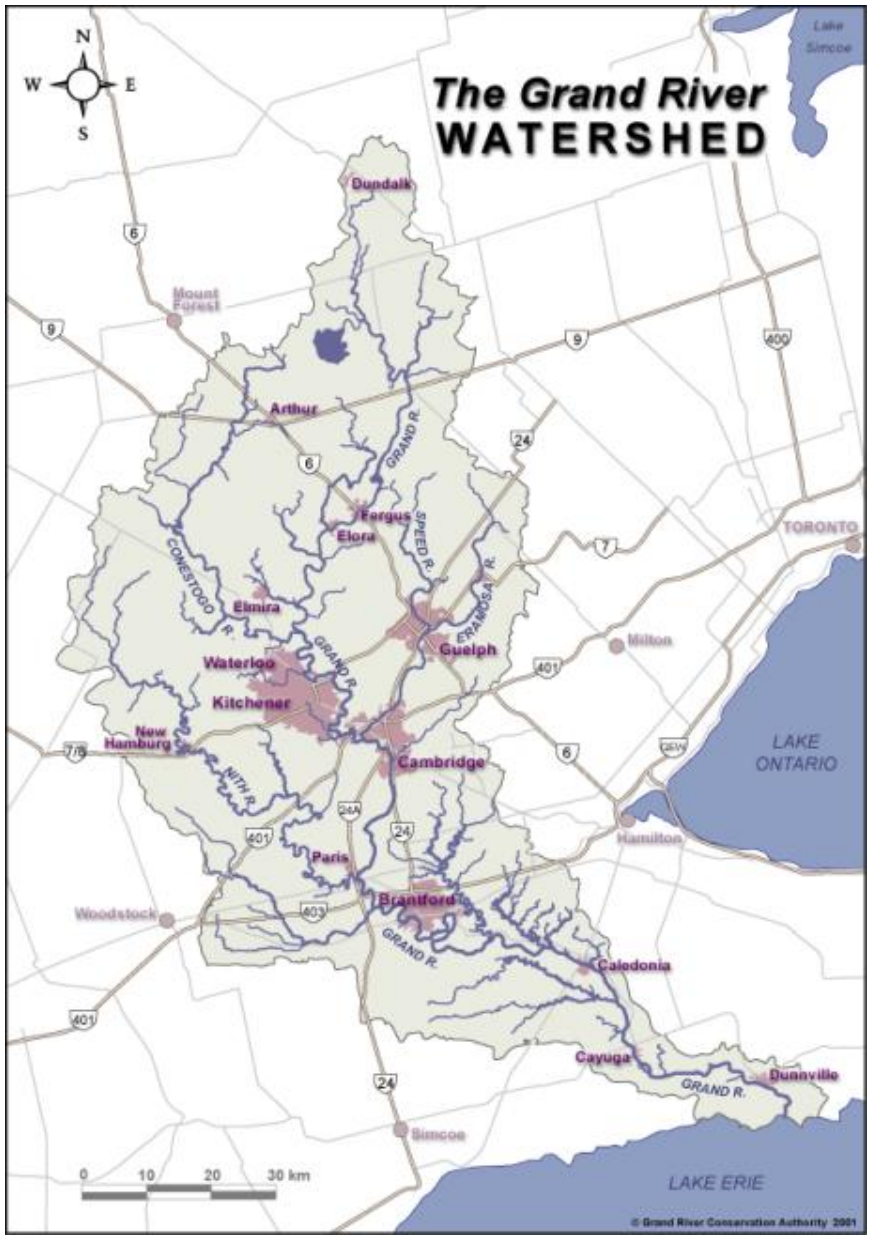
Grand River watershed

- 70% is actively farmed
- One million people
- Goals include: Improve water quality to improve river health and reduce the Grand's impact on Lake Erie
- Seeking BMPs for cash crops as well as livestock



Anne Loeffler, Conservation Specialist

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Water Quality Concerns

- In the Central Grand River:
  - **Nitrate** in winter/spring
  - **Phosphorus** in spring (high flow) and summer (low flow)
  - Sediment in spring (high flow) and summer (storm events)
  - **Ammonia** in summer (low flow)
- In the Southern Grand River:
  - **Phosphorus** in summer (low flow)
  - Sediment in summer (low flow)

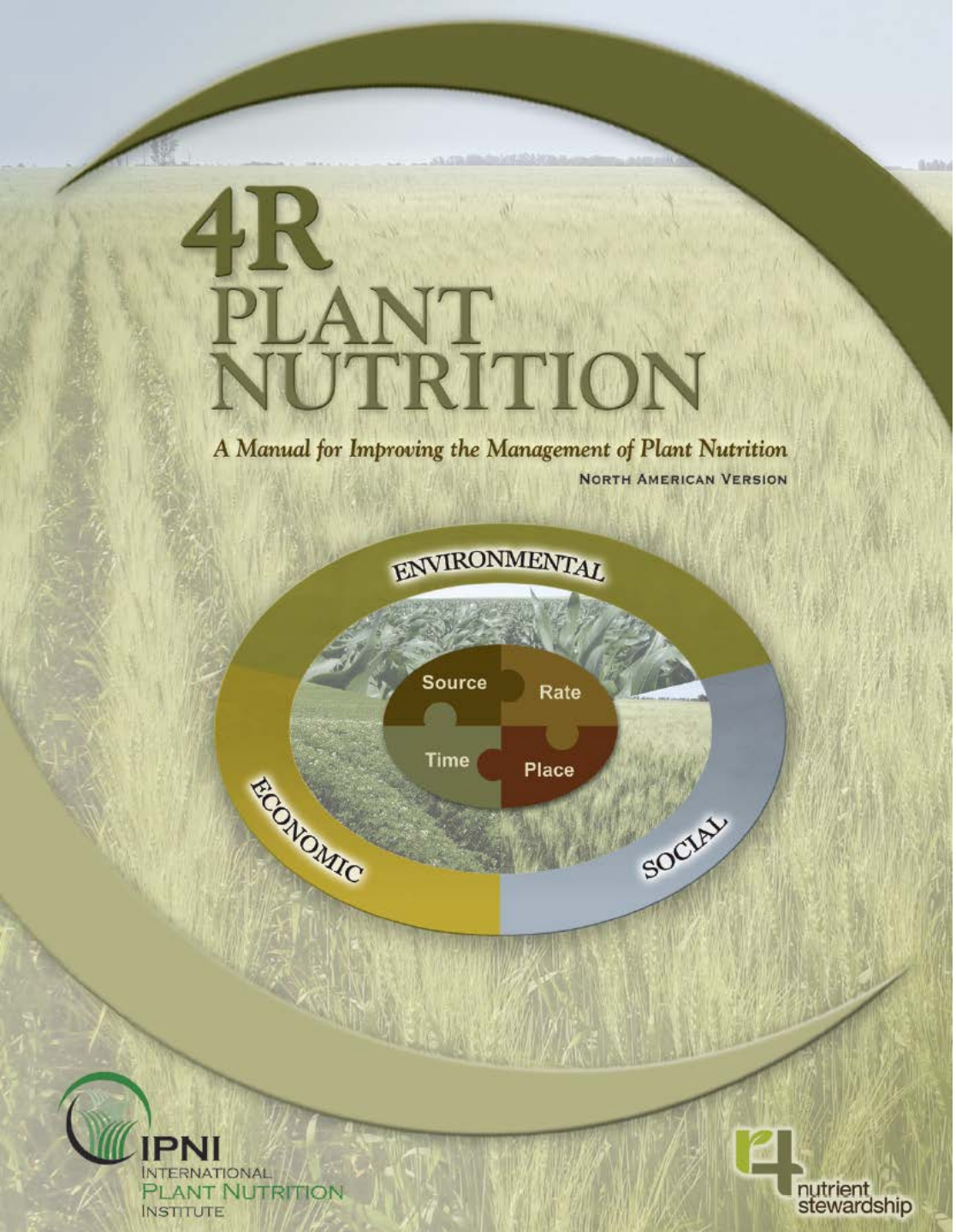
www.nutrientstewardship.com

“4R-Consistent” Checklist

1. Balance economic, social, environmental areas.
2. Include BMPs addressing SRTP.
3. Provide site-specific recommendations.
4. Balance essential elements.
5. Assess nutrient requirements.
6. Consider all sources.
7. Comply with regulations.
8. Measure effectiveness of BMPs.
9. Use terminology consistent with 4R standards.
10. Document plans and implementation.

The Fertilizer Institute

4 nutrient stewardship



Comments Welcome

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