AgroMart Annual Training Meeting – "Precision Counts"
15 November 2016
Guelph, Ontario, Canada

IPNI
INTERNATIONAL
PLANT NUTRITION
INSTITUTE

4R Implementation in Ontario
Phosphorus & Sustainability

4R nutrient stewardship

Tom Bruulsema, Phosphorus Program Director, IPNI
Ron Campbell, Operations and Member Services Manager,
Ontario Agri Business Association

Agrium Inc.

Arab Potash Company

BHP Billiton

CF Industries Holdings, Inc.

Compass Minerals Plant Nutrition

International Raw Materials LTD

Kingenta Ecological Engineering Group Co., Ltd.

K+S KALI GmbH

LUXI Fertilizer Industry Group

The Mosaic Company

OCP S.A.

PhosAgro

PotashCorp

Shell Sulphur Solutions

Simplot

Sinofert Holdings Limited

SQM

Uralchem, JSC

Uralkali

Yara International ASA

The **International Plant Nutrition Institute** is supported by leading fertilizer manufacturers.

Formed in 2007 from the Potash & Phosphate Institute, its mission is to develop and promote science for responsible management of crop nutrition

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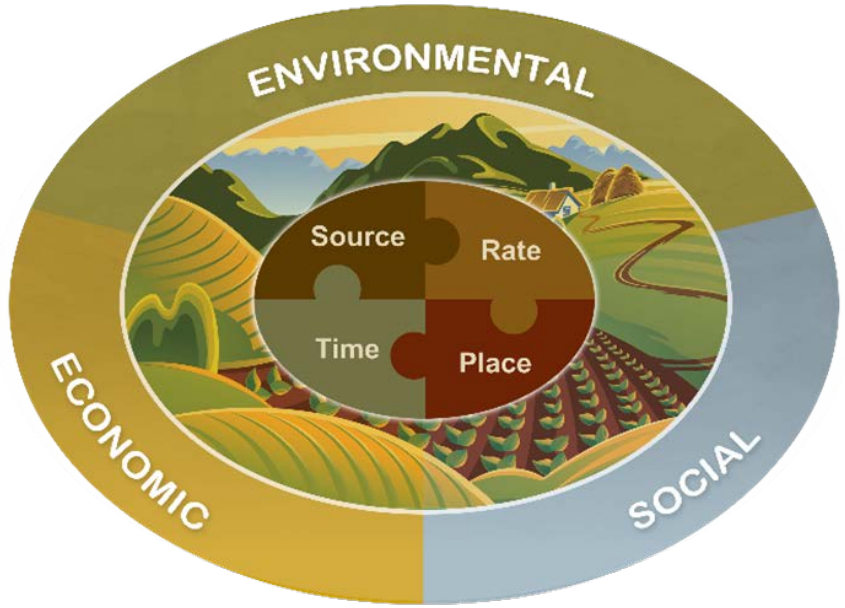
Outline

1. Sustainability, 4R, and Phosphorus – Tom
2. 4R Implementation in Ontario – Ron
3. Agronomic considerations for Ontario – Tom

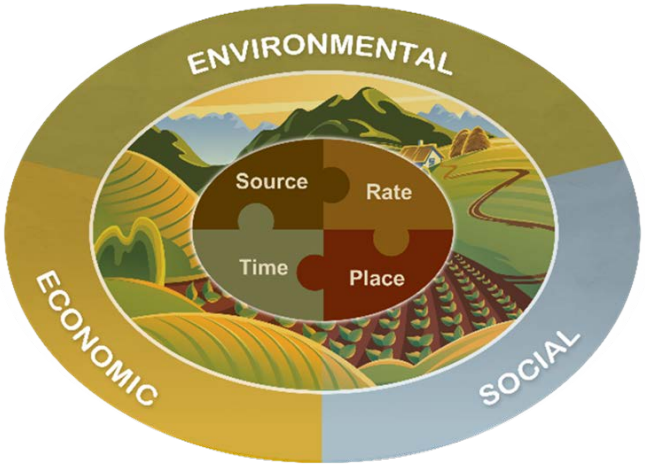


As a sustainability system,
4R Nutrient Stewardship
needs METRICS.

Nutrient Stewardship Metrics for Sustainable Crop Nutrition

Enablers (process metrics)

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



Actions (adoption metrics)

- Cropland area under 4R [Requires regional definitions of 4R practices]

Outcomes (impact metrics)

1. **Farmland productivity**
2. **Soil health**
3. **Nutrient use efficiency**
4. **Water quality**
5. Air quality
6. Greenhouse gases
7. Food & nutrition security
8. Biodiversity
9. Economic value

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Fieldprint® Calculator Sustainability Metrics

Field to Market®
The Alliance for Sustainable Agriculture

- Metrics that matter, usable at farm scale, linked to management with robust science
- Biodiversity, Energy Use, Greenhouse Gas Emissions, Irrigation Water Use, Land Use, Soil Carbon, Soil Conservation, **Water Quality**
- Current water quality metric is USDA NRCS WQI – qualitative
- Developing quantitative water quality outcome model to enable balancing among metrics
- Model requires definition of baseline and better practices
  - Nutrients (N & **P**), sediment, and pesticides

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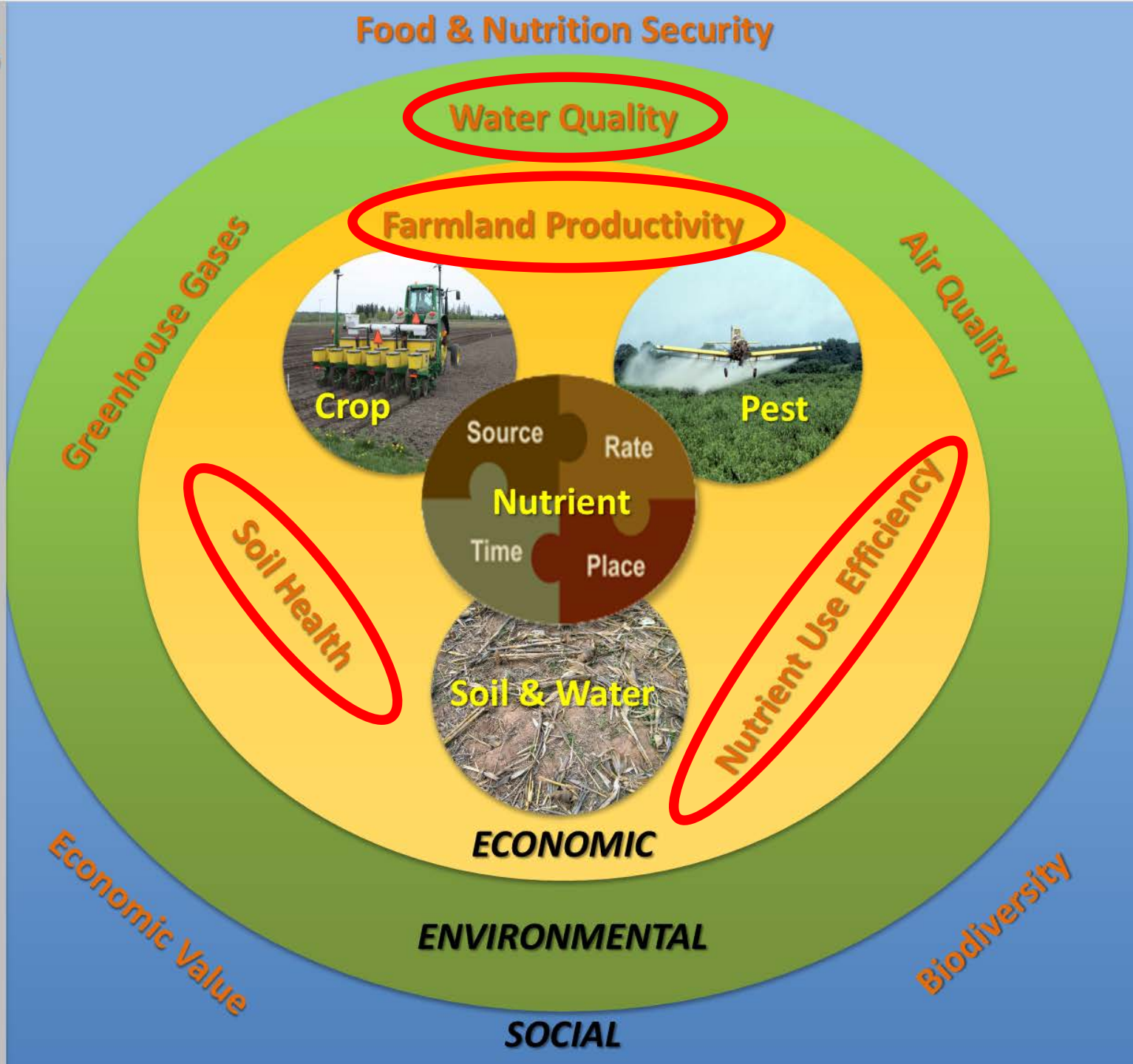
4R Outcome Metrics are influenced by 4R and more.

OUTCOMES

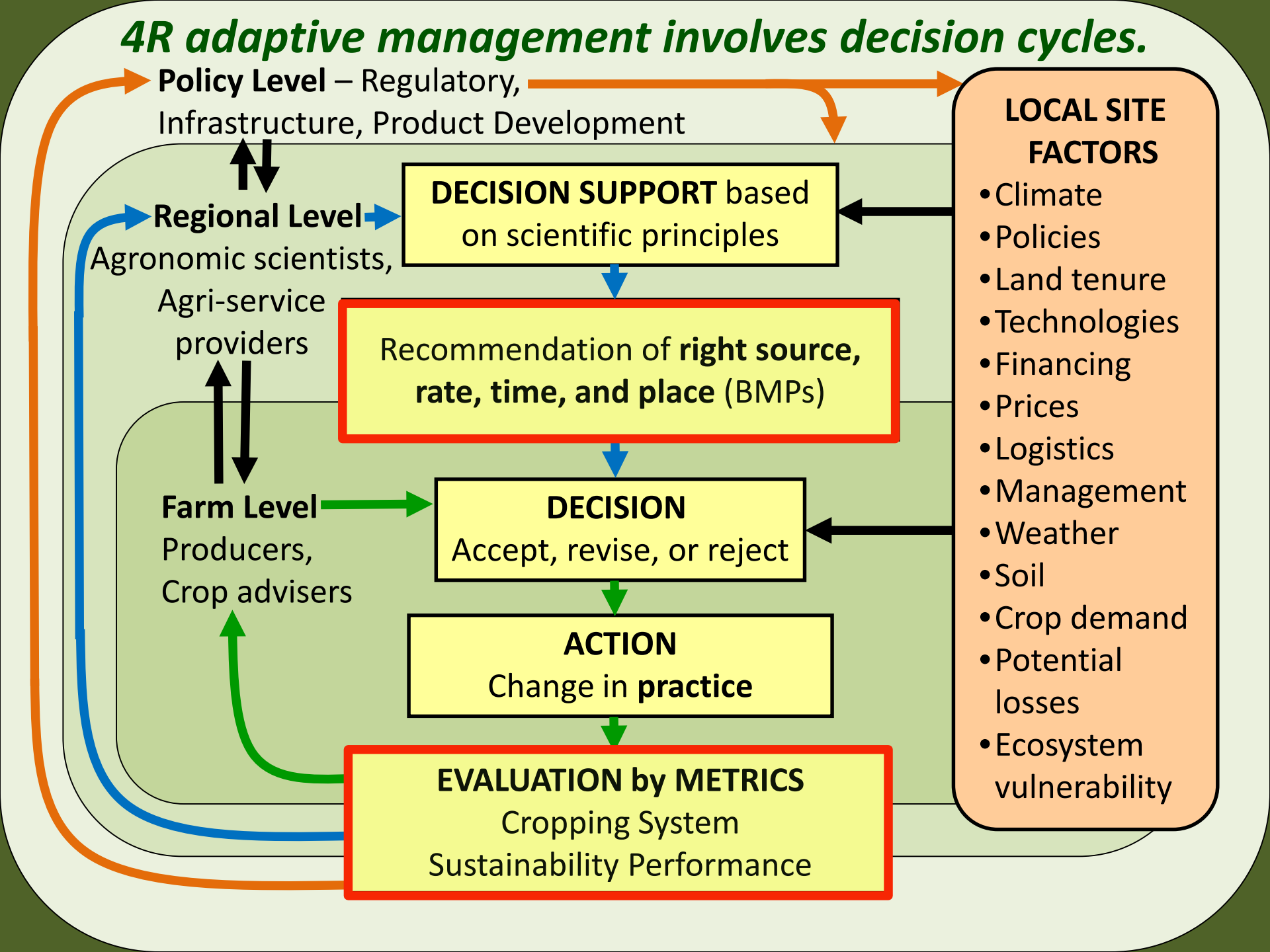
of

4 nutrient stewardship

are influenced by **crop and pest management,** and by **soil and water conservation practices** in the context of changing **weather and climate.**



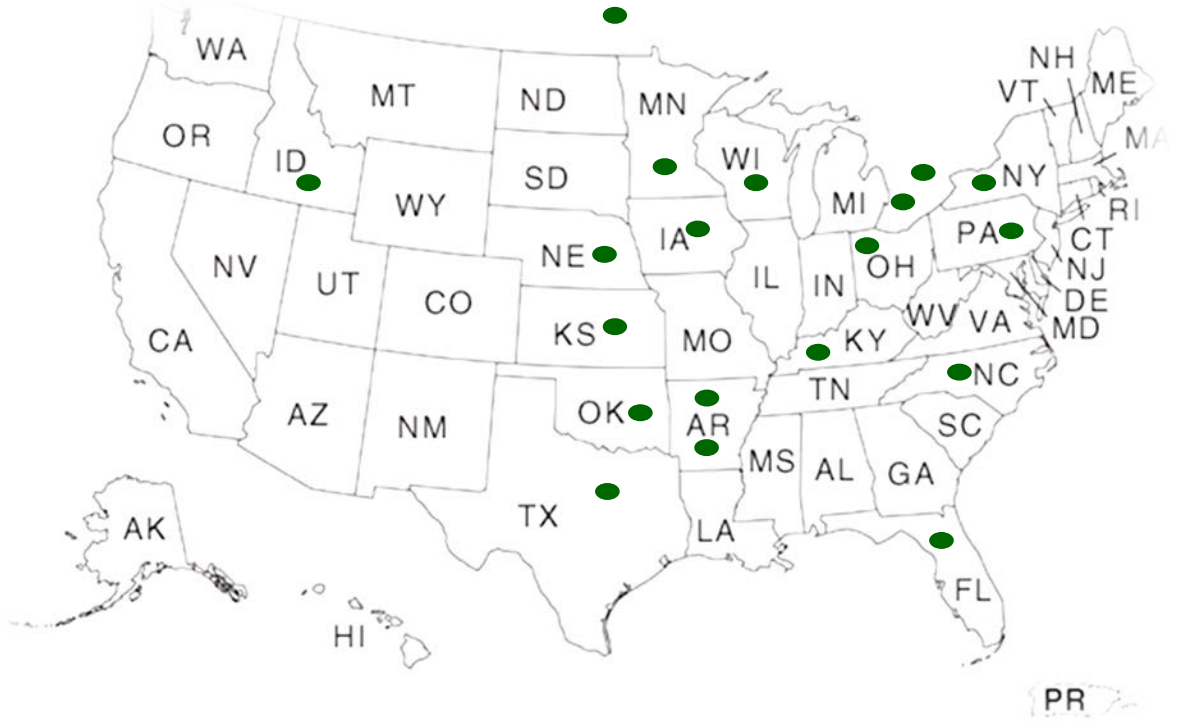
Adaptive Management addresses 4R metrics at scales ranging from farm to global.


4R adaptive management involves decision cycles.
Policy Level – Regulatory, Infrastructure, Product Development
Regional Level
Agronomic scientists, Agri-service providers
Farm Level
Producers, Crop advisers
DECISION SUPPORT based on scientific principles
Recommendation of right source, rate, time, and place (BMPs)
DECISION
Accept, revise, or reject
ACTION
Change in practice
EVALUATION by METRICS
Cropping System Sustainability Performance
LOCAL SITE FACTORS
•Climate
•Policies
•Land tenure
•Technologies
•Financing
•Prices
•Logistics
•Management
•Weather
•Soil
•Crop demand
•Potential losses
•Ecosystem vulnerability

Defining 4R phosphorus practices at the continental scale.

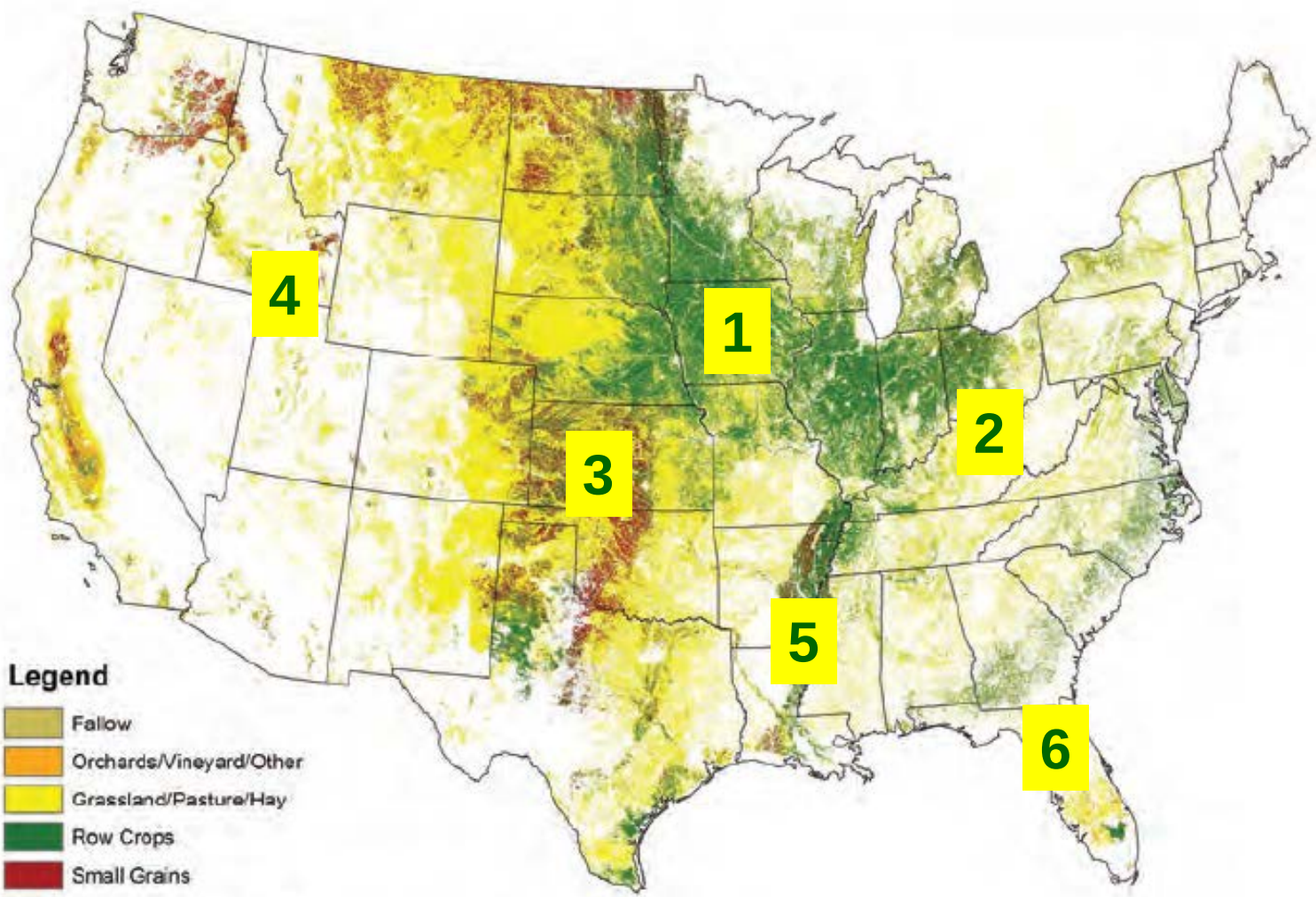
4R P Practices - Participating Scientists

1. **Brian Arnall**, Oklahoma State U
2. **Doug Beegle**, Penn State U
3. **Don Flaten**, U of Manitoba
4. **Laura Good**, U of Wisconsin
5. **Kevin King**, USDA-ARS, Columbus, OH
6. **Quirine Ketterings**, Cornell U
7. **Josh McGrath**, U of Kentucky
8. **Antonio Mallarino**, Iowa State U
9. **Rao Mylavarapu**, U of Florida with input from other colleagues.
10. **David Mulla**, U of Minnesota
11. **Nathan Nelson**, Kansas State U
12. **Keith Reid**, Agriculture and Agri-Food Canada
13. **Nathan Slaton**, U of Arkansas
14. **Charles Shapiro**, U of Nebraska
15. **Andrew Sharpley**, U of Arkansas
16. **Doug Smith**, USDA-ARS, Temple, TX
17. **Ivan O'Halloran**, U of Guelph
18. **Deanna Osmond**, North Carolina State U
19. **David Tarkalson**, USDA-ARS, Kimberly, ID



Regions and Cropping Systems

1. Western Corn and Soybean
2. Eastern Cereals and Oilseeds
3. Wheat in the Great Plains
4. Irrigated Potatoes in the Northwest
5. Rice
6. Irrigated vegetables



2011 National Land Cover Database - http://www.mrlc.gov

Table 2: General and Specific 4R Phosphorus Application Practices for Eastern Cereals & Oilseeds

Level	Right Source	Right Rate	Right Time	Right Place
Basic	All sources applied have known or guaranteed analysis. Manures have current nutrient analysis or current book values.	Rates are based on current soil tests using recognized sampling and analytical procedures, and recognized evidence based recommendations. All P sources are accounted for. Application equipment is maintained and calibrated. Current soil tests are taken within the last 3 years. Rate does not exceed 3 years anticipated crop removal.	Applications are not made when soils are frozen or snow covered unless based on recognized guidelines. Surface applications are made only when risk of runoff is recognized to be low.	Banding or injecting below the soil surface is encouraged. Where P is broadcast, it is either incorporated into the soil before runoff occurs, or applied only where low risk of runoff is recognized. For no-till management, P is placed in subsurface bands.
Inter-mediate	As in basic, plus: Manures have farm-specific nutrient analyses using recognized sampling procedures.	As in basic, plus: A recognized P index is used when recommended. Anticipated crop removal is based on past documented crop yields. Rate does not exceed 2 years anticipated crop removal.	Applications are not made when soils are frozen or snow covered. A recognized P index is used when recommended. Applications are made close to or at planting.	As in basic, plus: A recognized P index is used where recommended Starter (e.g. 2"x2" or in row) is used if recommended. Use appropriate placement to avoid crop injury given fertilizer rate and source.
Ad-vanced	• As in intermediate.	• As in intermediate, plus: • Fields are subdivided to receive zone-specific rates based on loss potential as well as crop response potential. • Rate does not exceed recommendation for the current crop. • A recognized P index is used.	• As in intermediate, plus: • A recognized P index is used.	• As in intermediate, plus: • A recognized P index is used.

1. All nutrient management practices meet or exceed requirements of locally applicable regulations.
2. Management of soil pH, lime and other nutrients is assumed to follow locally appropriate practices.
3. The term "recognized"—when used in reference to recommended practices, tools or interpretations—is taken to mean recognized as an agency entrusted with the task of providing such recommendations. These may include land grant universities appropriate to each state, government extension agencies in Canadian provinces, or multi-stakeholder bodies (including universities and/or government extension agencies) established to provide recommendations relevant to soil fertility and plant nutrition.
4. Conservation practices (field and farm specific) are used to minimize sediment and nutrient loss in surface runoff and tile discharge.
5. The producer or adviser involved in making the practice decisions is encouraged to meet or exceed a knowledge standard equivalent to that of a Certified Crop Adviser or Certified Nutrient Management Planner, preferably with demonstrated knowledge of principles of 4R Nutrient Stewardship.

4R efficacy for reducing P loss, % reduction

- ranges found in field experiments across the USA and Canada

Practice	Dissolved P	Particulate P
Source	---	---
Rate	60 to 88%	negligible
Time	41 to 42%	negligible
Place	20 to 98%	-60% to NS
Soil inversion	NS to 92%	-59% to NS
Conservation tillage	-308 to -40%	-33 to 96%

Dodd & Sharpley, 2015. Nutrient Cycling in Agroecosystems.

1. **Wide range of efficacies demands more site-specific focus.**
2. **Trade-off between dissolved and particulate is important.**

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4R Implementation in Ontario

Agromart Growing Innovation Meeting

Ron Campbell

November 15, 2016

nutrient stewardship

Memorandum of Cooperation

- OABA along with Fertilizer Canada and Ontario government signed Memorandum of Cooperation in September 2015
- MoC recognizes role 4R Nutrient Stewardship can play in managing environmental impact of crop nutrients while ensuring sustainable crop production

4R Program National

- Fertilizer Canada (F.C.) along with International Plant Nutrition Institute and the Fertilizer Institute (U.S.) created 4R Nutrient Stewardship program
- F.C. has MoC's in New Brunswick, PEI, Manitoba, Alberta, Saskatchewan
- F.C. has created online training for agronomists and farmers
- F.C. helped fund creation of CCA 4R Specialization program
- F.C. established 4R acre designation program – online registry for 4R consistent acres
- Goal of 20 million 4R designated acres across Canada

4R Steering Committee

- Steering Committee established
- 3 Signing partners
- Additional representation from Conservation Authorities, GFO, OFA, CFFO
- Science & Technology working group
  - Ensure 4R approach is science-based and practical
  - Includes reps from livestock groups and AAFC
  - Brandon Yott is a member of this committee

4R Steering Committee

- $300,000 funding from OABA and F.C.
- OMAFRA providing funding for specific projects
- Communications efforts
  - GFO Conference
  - Farm tour
- Pilot Projects
  - 4R Acre Designation
  - Retailer Certification

4R Designated Acres

- 20 OABA Retailer volunteered to participate in pilot
- Has been a challenge for participants
- Based on best practices and continuous improvement
- Agronomists more comfortable with pass/fail?
- Difficult to ‘judge’ practices of farmer

Retailer Certification

- Ontario 4R conducted a pilot project looking at retailer certification program developed in Ohio
- Four Ontario retailers audited
- Audits conducted by Ohio 4R auditor using 41 Ohio guidelines (slightly modified)
- Feedback from participants has been positive

Next Steps

- Retailer Certification Auditor prepared report
- Has been reviewed by OABA Crop Inputs Committee
- Ontario 4R Steering Committee will review options and determine direction of 4R in Ontario
- Need to create program that meets needs of producers, industry, government and the public

If Retailer Certification…

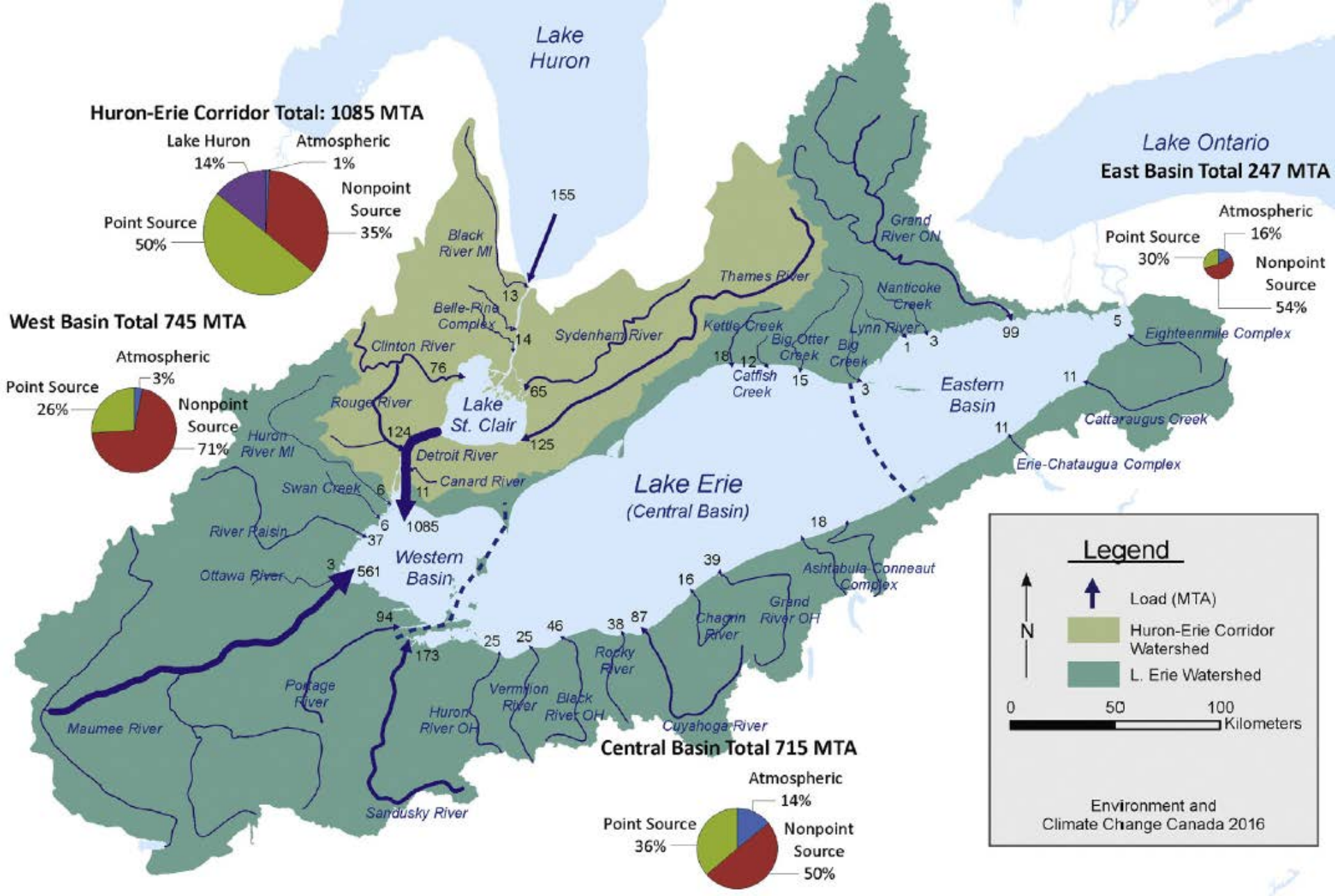
- Will create some changes in retailer/producer relationship
- Documentation
  - Producer designation for application
  - Soil test required for recommendation
- Training
  - CCA 4R designation
  - Requirement for producer training
- Weather Recording
  - Incorporation before rain event

Challenges…

- Incorporating livestock and poultry sectors
  - How will it mesh with NMA
  - Manure testing
  - Spreading on Frozen or Snow Covered Ground
- Recommendations
  - Vegetable recommendations
  - Ontario recommendations vs Industry recommendations

Agronomic Considerations

Western Lake Erie Watershed
4R Certification Program
Ontario



Maccoux, M.J., et al., **Soluble reactive phosphorus loadings to Lake Erie**, J. Great Lakes Res. (2016), http://dx.doi.org/10.1016/j.jglr.2016.08.005

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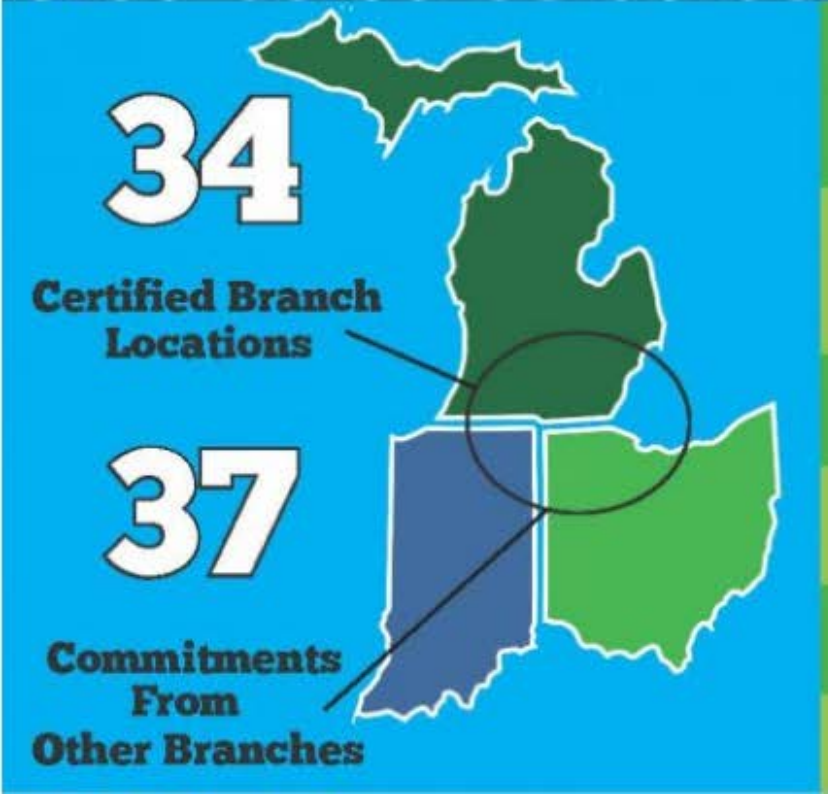
4R NUTRIENT STEWARDSHIP CERTIFICATION PROGRAM

Western Lake Erie Basin - Ohio, Michigan, and Indiana



Acres serviced or applied in WLEB	1,900,000
Acres outside WLEB serviced or applied	800,000
Total	2,700,000

4R NUTRIENT STEWARDSHIP CERTIFICATION

Number of Clients Serviced in WLEB	4,000
Clients Serviced Outside WLEB	1,500
Total	5,500

2.7M acres in OH-IN-MI

extending to all of Ohio

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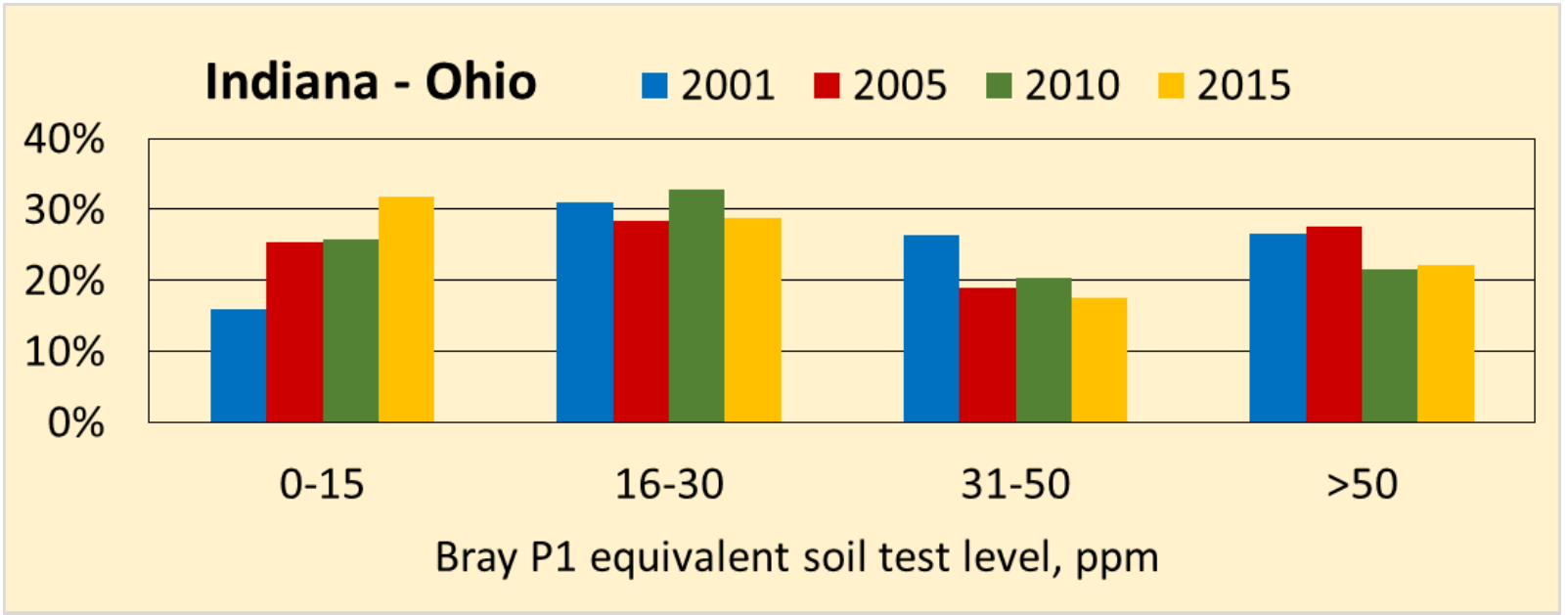
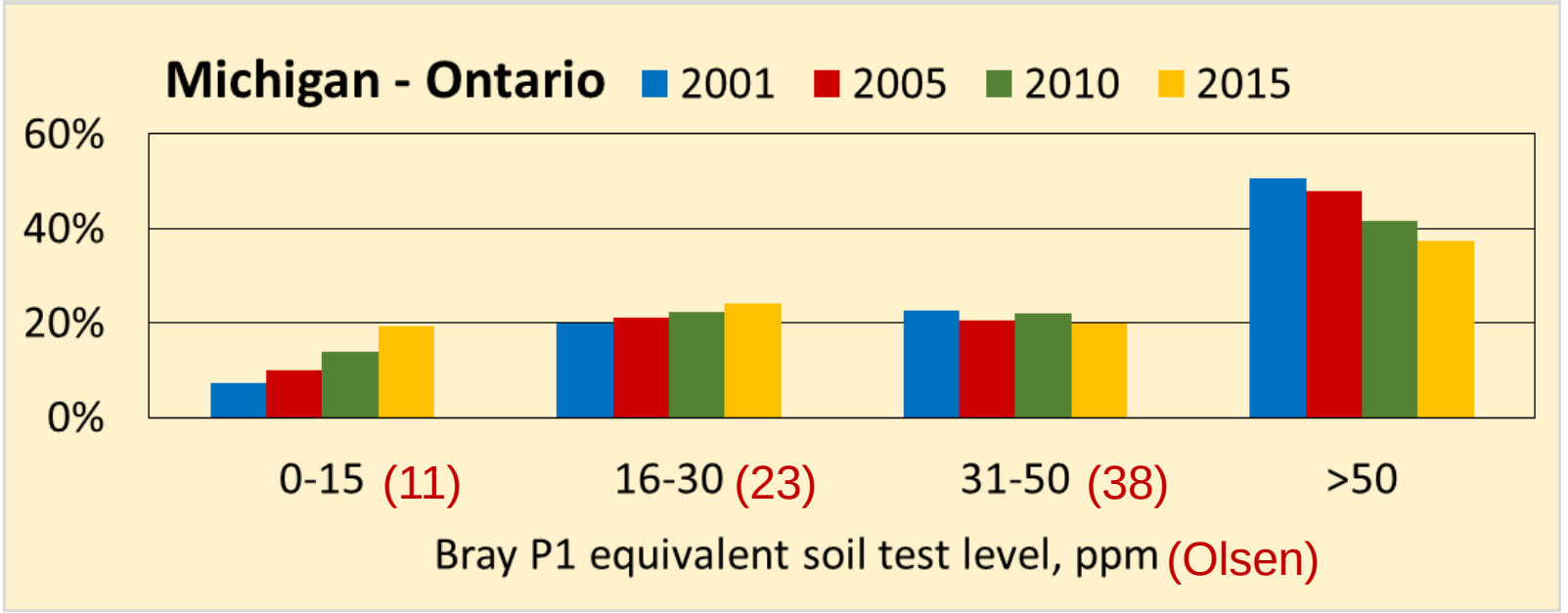
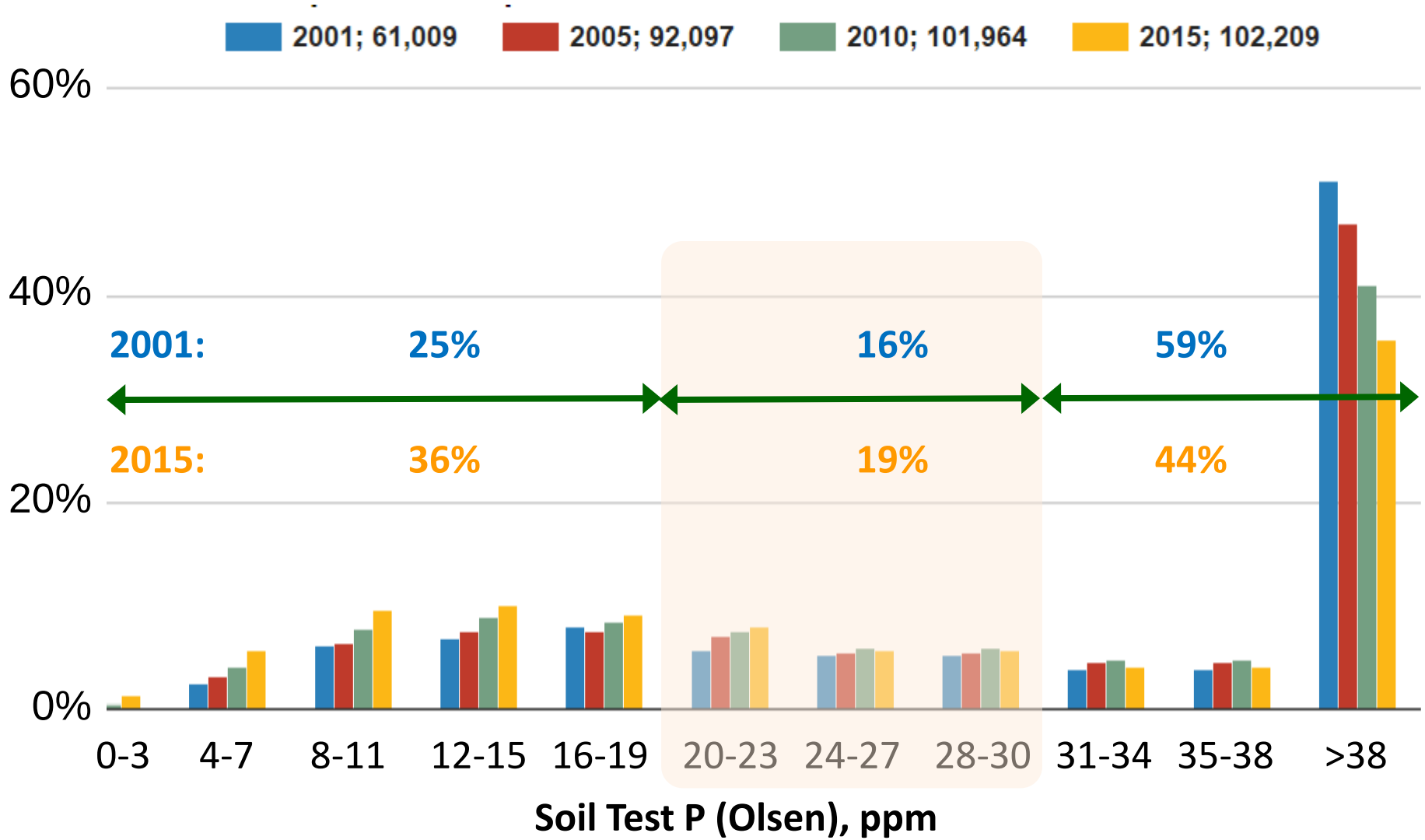
Phosphorus legacy differs by region

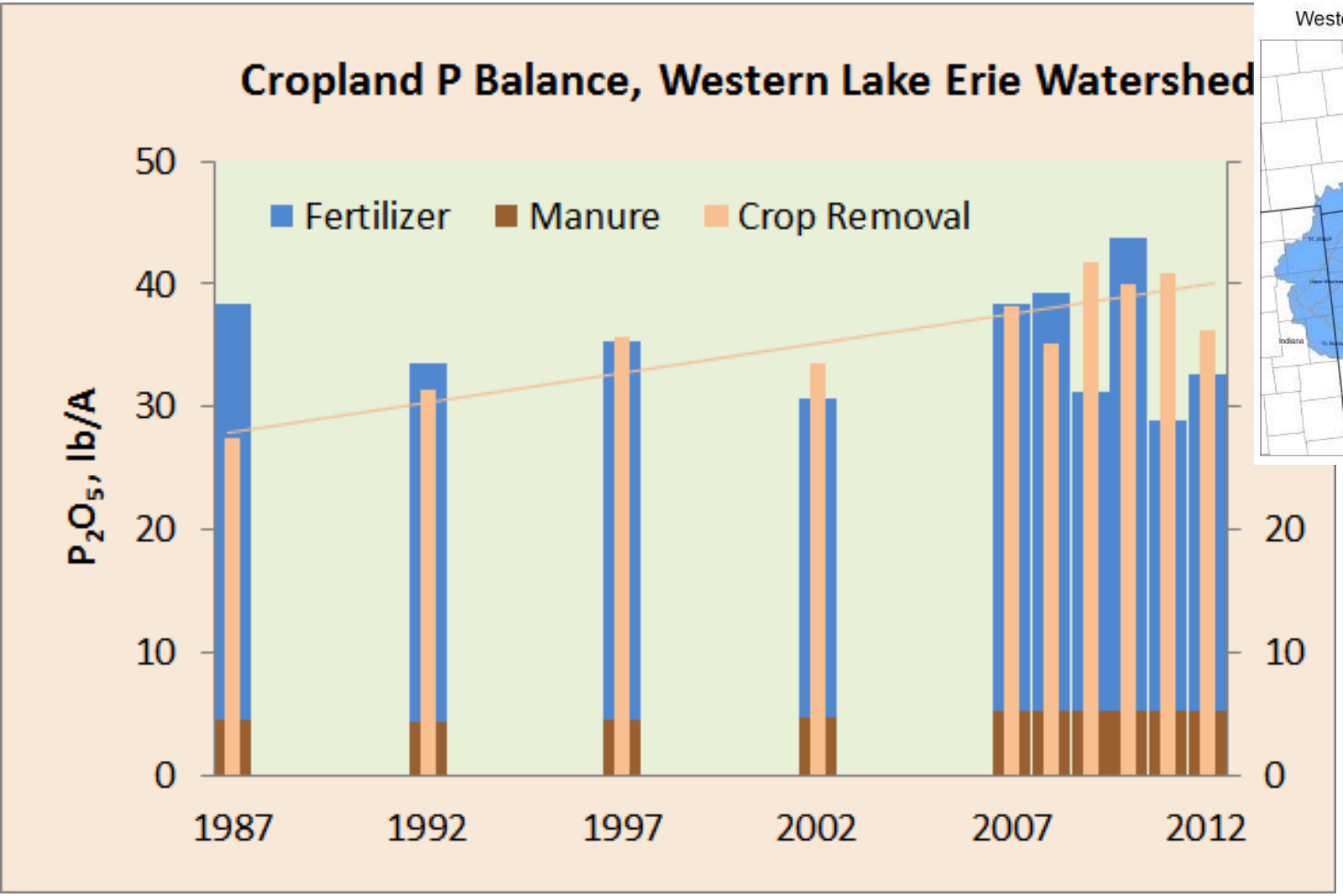




Ontario has more soils very high in P than Ohio



http://soiltest.ipni.net



1. Crop removal increasing with yield.
2. Application rates falling short of crop removal.

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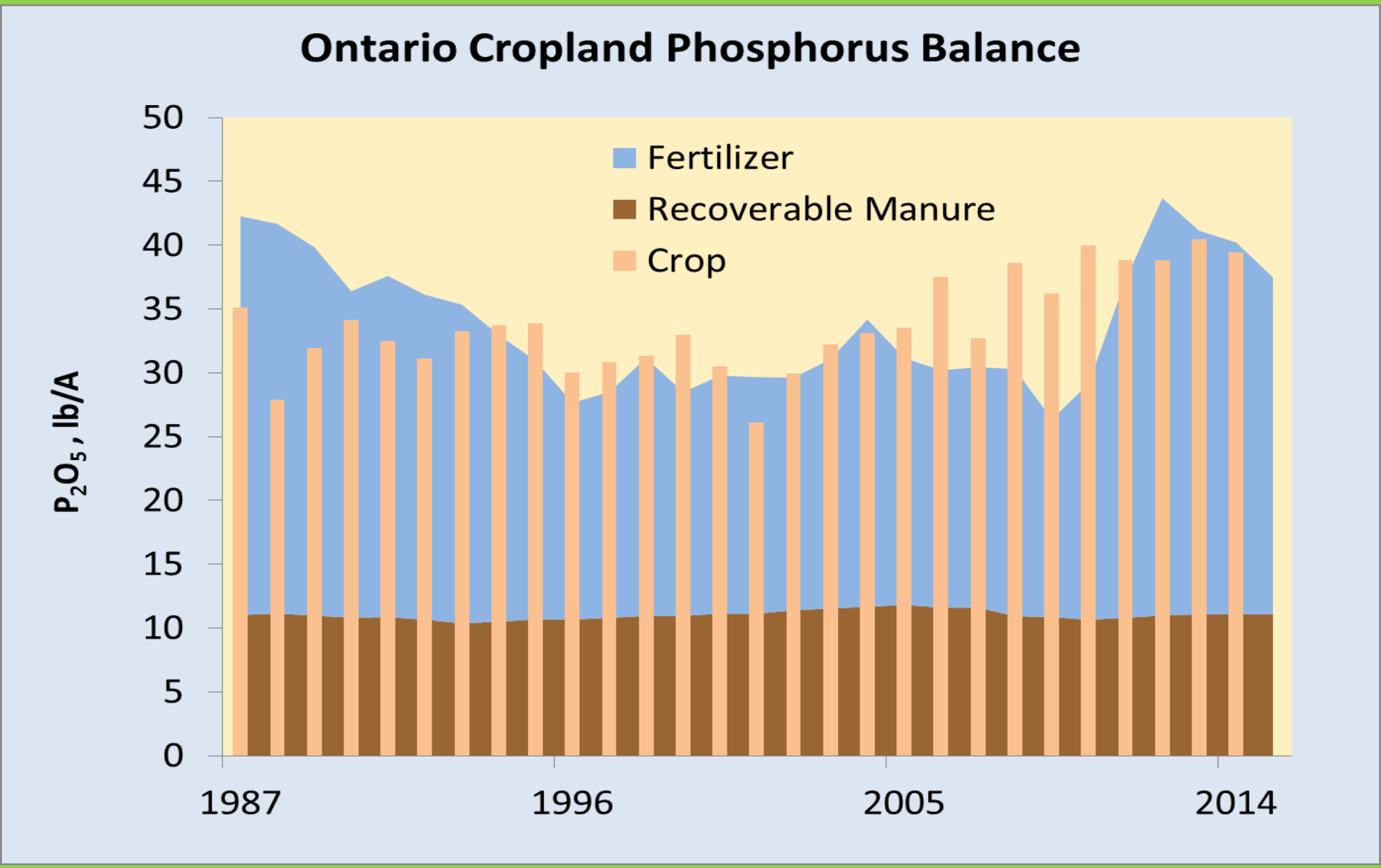
NuGIS
Nutrient Use Geographic Information System



Ontario's P balance: more manure than in the Lake Erie watershed

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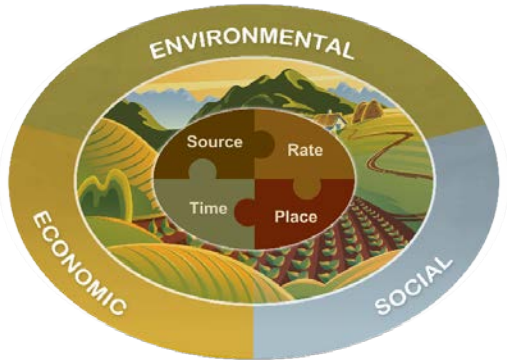
Summary

- The sustainability movement can increase public appreciation of industry efforts to implement 4R phosphorus practices.
- The Western Lake Erie 4R Certification program offers a model of 4R implementation that needs adaptation for Ontario.
- The agri-retail industry can help document
  1. trends in source-rate-time-place combinations; and
  2. impacts on yield, soil fertility, nutrient balance and water quality.

4 nutrient stewardship



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