



International Plant Nutrition Institute
Board of Directors Meeting
Boston, MA, USA
29 September 2015

Global Opportunities for Phosphorus Stewardship



Tom Bruulsema, Phosphorus Program Director
Guelph, Ontario, Canada

Outline

1. Who is IPNI's new Phosphorus Program Director?
2. Why is IPNI starting a Phosphorus Program?
 - The emerging academic discipline of Phosphorus Sustainability
 - Phosphorus Sustainability Issues from industry and academic perspectives
3. What will the Phosphorus Program do?
 - Tactical Plan
 - Metrics for sustainable P nutrition
 - Lake Erie watershed 4R implementation

Tom Bruulsema – background

- University of Guelph
 - BSc and MSc in Crop Science
 - Interests in modeling crop physiology, and N transfer clover to corn
- Bangladesh 1986-1990
 - Agronomic research on rice, wheat, pulses, soybeans
- Cornell University 1991-1993
 - PhD in N cycling with JM Duxbury
- University of Minnesota 1994
 - Postdoc with G Malzer and PC Robert
 - spatial variability of corn N response
- PPI/IPNI since Dec 1994
 - Dairy forage K, organic agriculture, fertilizer & functional foods, N and weather, 4R nutrient stewardship...





Ancaster, Ontario – 26 June 2009 – tilled corn
SOIL EROSION: A REAL RISK OF PHOSPHORUS LOSS



**North of Guelph, Ontario – 6 April 2014 – no-till
DISSOLVED PHOSPHORUS IN RUNOFF – AN INVISIBLE RISK**

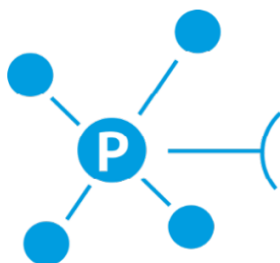
IPNI Phosphorus Program – why?



August 16-20, 2016
Kunming, Yunnan, China



5th Sustainable Phosphorus Summit 2016
(SPS 2016)

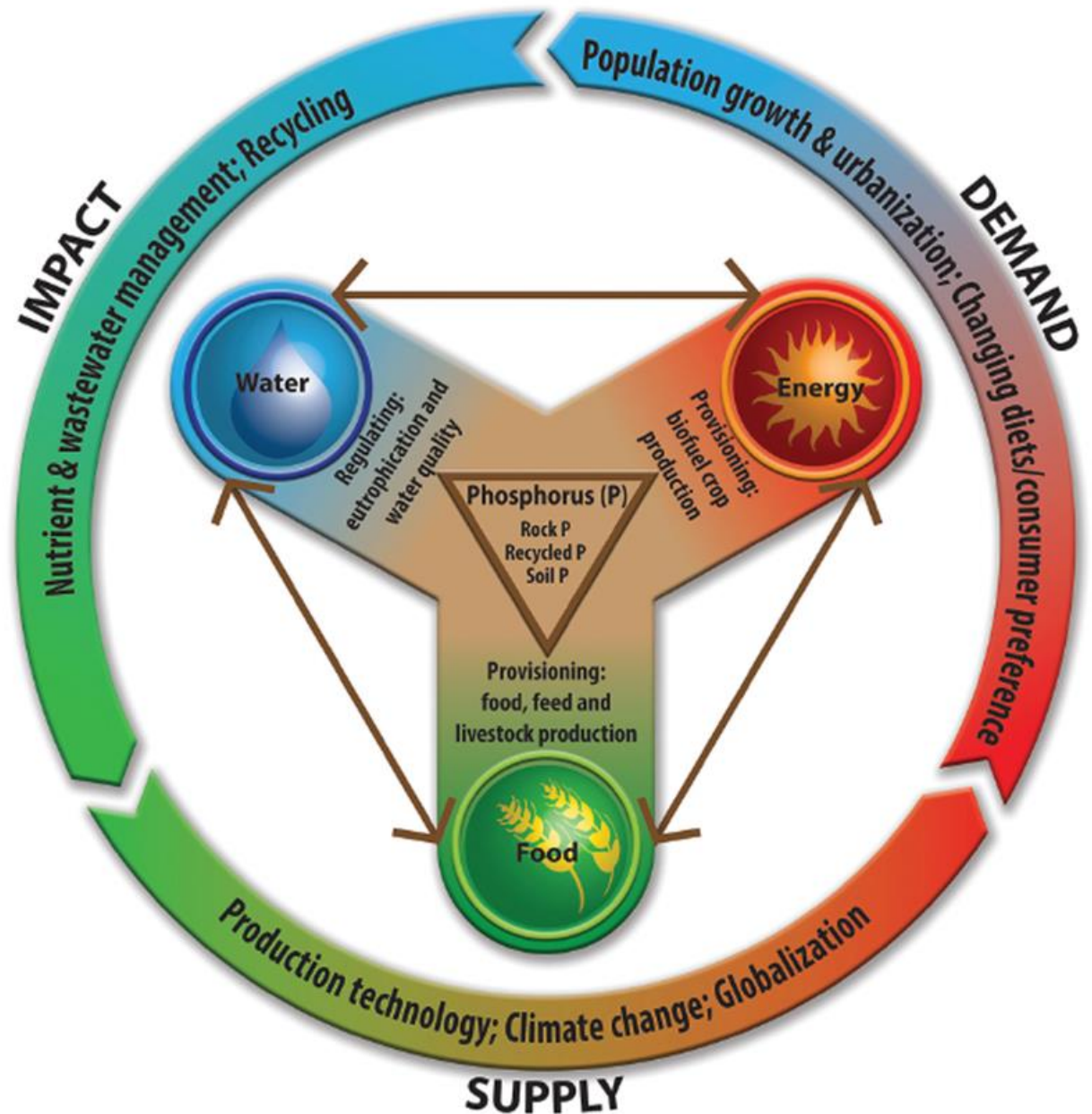


European Sustainable Phosphorus Platform

September 2015 n° 116

SCOPE NEWSLETTER

The Pivotal Role of Phosphorus in a Resilient Water–Energy–Food Security Nexus



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Phosphorus Sustainability Research Coordination Network



Summary: The Phosphorus Sustainability Research Coordination Network (P-RCN) was funded by the U.S. NSF to identify solutions for P sustainability by sparking an interdisciplinary synthesis of data, perspectives, and understanding about phosphorus. The P-RCN has over 50 academic participants and meets annually to engage stakeholders and coordinate and integrate P sustainability research.

[Sustainable P](#)

Theme: Policy, Justice and Culture; Resilience; Agri-business and Supply Chain; Health and Nutrition; Education

Faculty: Jim Elser, Bruce Rittmann, Rimjhim Aggarwal, Dan Childers, Helen Rowe, Jared Stoltzfus, Jennifer Hodbod, Mac Gifford, Neng long Chan, Paul Westerhoff.

Scientists gather in DC to tackle phosphorus sustainability issues

- ARIZONA STATE UNIVERSITY press release May 2015
- Tempe, Ariz. -- Researchers from Arizona State University, along with more than 40 other scientists, engineers, technical experts and policy makers from around the world, are convening in Washington, D.C. May 18-21 to study ways to create a sustainable phosphorus (P) fertilizer system.
- The **use of phosphorus**, a key component of fertilizers, is increasing around the world. **As a result**, the runoff of phosphorus from farms and cities is creating **noxious algal blooms, which often lead to "dead zones"** in rivers, lakes and coastal oceans.
- ...experts believe **humanity's phosphorus use has already exceeded "safe boundaries"** and are calling for solutions both to protect water quality and assure long-term reliable supplies of P for fertilizer....

PHOSPHORUS,



FOOD,



and our FUTURE



Edited by

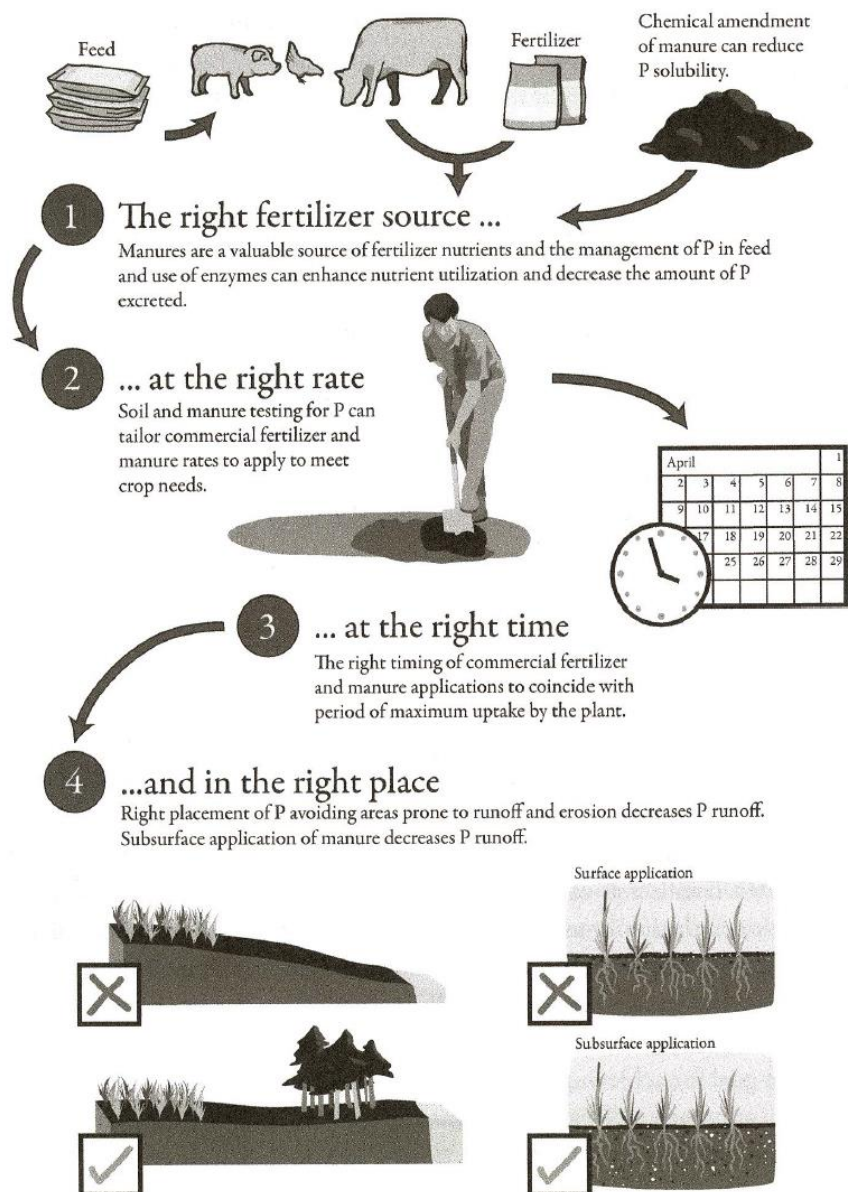
Karl A. Wyant, Jessica R. Corman, & James J. Elser

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Phosphorus Sustainability Science

- “Phosphorus Footprint”
- “Wicked problems”
- “P accessibility”
- “Circular economy”
- “Closing the loop”
- “...current approaches to P resources and P-use [are] inadequate, even failed”
- “Sustainability scientists also aim to participate in decision-making processes, as opposed to simply providing information to decision makers.”

The 4 “Rs” of P Application



IPNI has already engaged with P sustainability scientists



Jim Elser

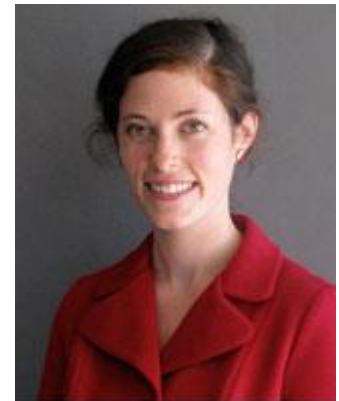
@ArizonaJJE FOLLOWS YOU

limnologist, traveller, inordinate interest in phosphorus

FIGURE 4.6 A possible management solution for fertilizer use is termed the *Right Source, Right Rate, Right Time, Right Place* concept, which is also known as 4R nutrient stewardship (International Plant Nutrition Institute).

The Story of Phosphorus: 7 reasons why we need to transform phosphorus use in the global food system

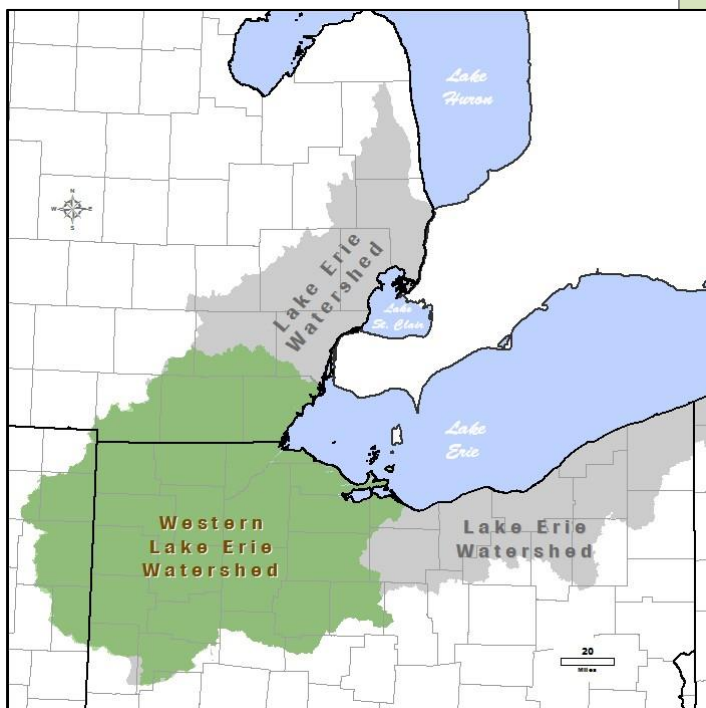
Dr. Dana Cordell, *Research Principal*, Institute for Sustainable Futures, University of Technology Sydney (UTS) Australia



1. Phosphorus equals food
2. Growing food demand, growing phosphorus demand
3. Finite phosphate: we've used up the good stuff
4. Geopolitical risks: an issue of national security?
5. An inefficient global food system
6. Cheap fertilizer – a thing of the past for farmers
7. No one is monitoring phosphorus: whose responsibility is it?

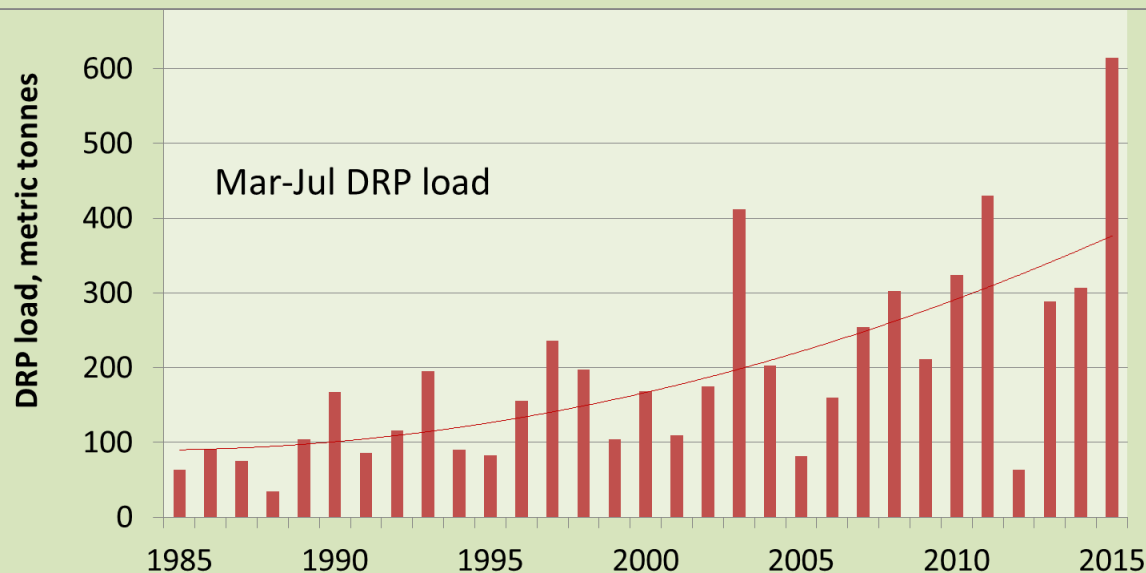
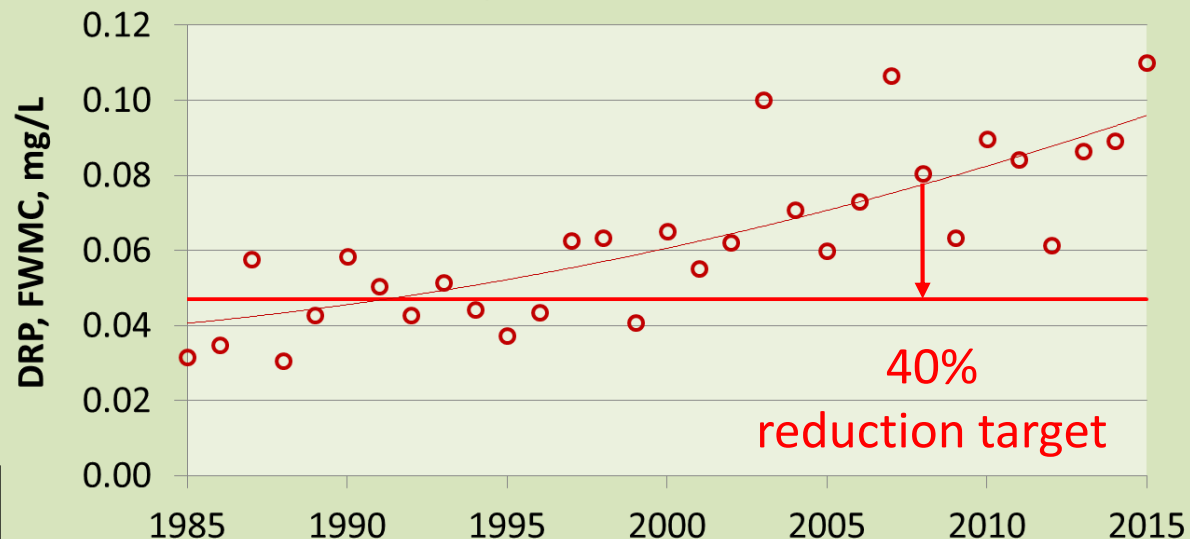
***IPNI – engages some (1, 2, 3, 5) but not all of the above.
– sees water quality as another urgent issue.***

Western Lake Erie: dissolved P trends increasing since early 1990s



Maumee River, Mar-Jul DRP, 1984-2015

flow-weighted mean concentration



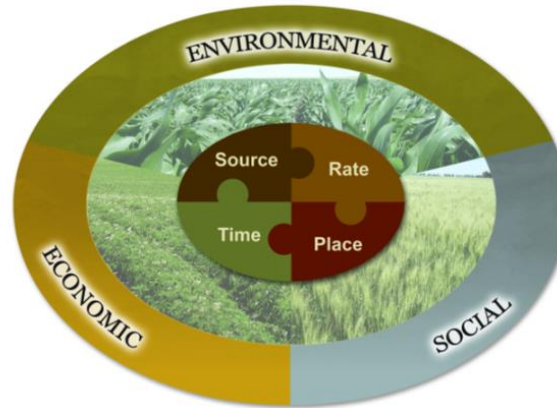
IPNI Phosphorus Program: Key Responses

1. 4R Science
 - Engage leading scientists to establish 4R phosphorus practices
2. Education
 - Phosphorus Fellowship Program
3. Recommendations
 - Decision support for P rate, time & place
4. Yield gaps
 - P contribution to farmland productivity
5. Sustainability
 - GPNM-PTT, P-RCN, Field to Market
 - Metrics for water quality

[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)

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

Lake Erie 4R implementation

- Certification
- Research – 4R Fund Project



Edge of Field

Watershed

Lake Erie



4R Research Fund: Evaluating the 4R Nutrient Stewardship Concept and Certification Program in the Western Lake Erie Basin

- 4R Practices and the 4R Certification Program
- 12 collaborating scientists... land-river-lake continuum... 2014-2019
- Ohio State U, USDA-ARS, Heidelberg U, LimnoTech, TNC

Project lead
Kevin King
USDA-ARS,
Columbus,
OH



Phosphorus Program

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Lake Erie P Issues

Algae blooms in Lake Erie have been increasing over the past 15 years or so, especially in 2011 and 2013. Algal growth is often limited by phosphorus (P). Runoff from cropland is one of the sources of P in tributaries draining into Lake Erie. Learn how agri-service providers and producers are minimizing runoff losses by implementing 4R Nutrient Stewardship, by following the links to the presentations and publications below. To see current satellite photos of Lake Erie at the NOAA CoastWatch site, click on "Learn More."

[Learn More](#)Sort by ▼

phosphorus.ipni.net

Summary: Phosphorus Stewardship Opportunities



1. The emerging science of phosphorus sustainability is gaining influence on scientists, policymakers and the public.
2. IPNI has opportunity to increase its engagement of phosphorus sustainability scientists.
3. More attention from both research scientists and practitioners on reducing P losses that impact water quality.
4. 4R Nutrient Stewardship provides the framework for research, adaptive management, and rebuilding of public trust.