2012 FREP Conference

IPNI
INTERNATIONAL
PLANT NUTRITION
INSTITUTE

The 4 R's of Plant Nutrient Management – The Industry Perspective

Rob Mikkelsen, CCA
Director, Western North America

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

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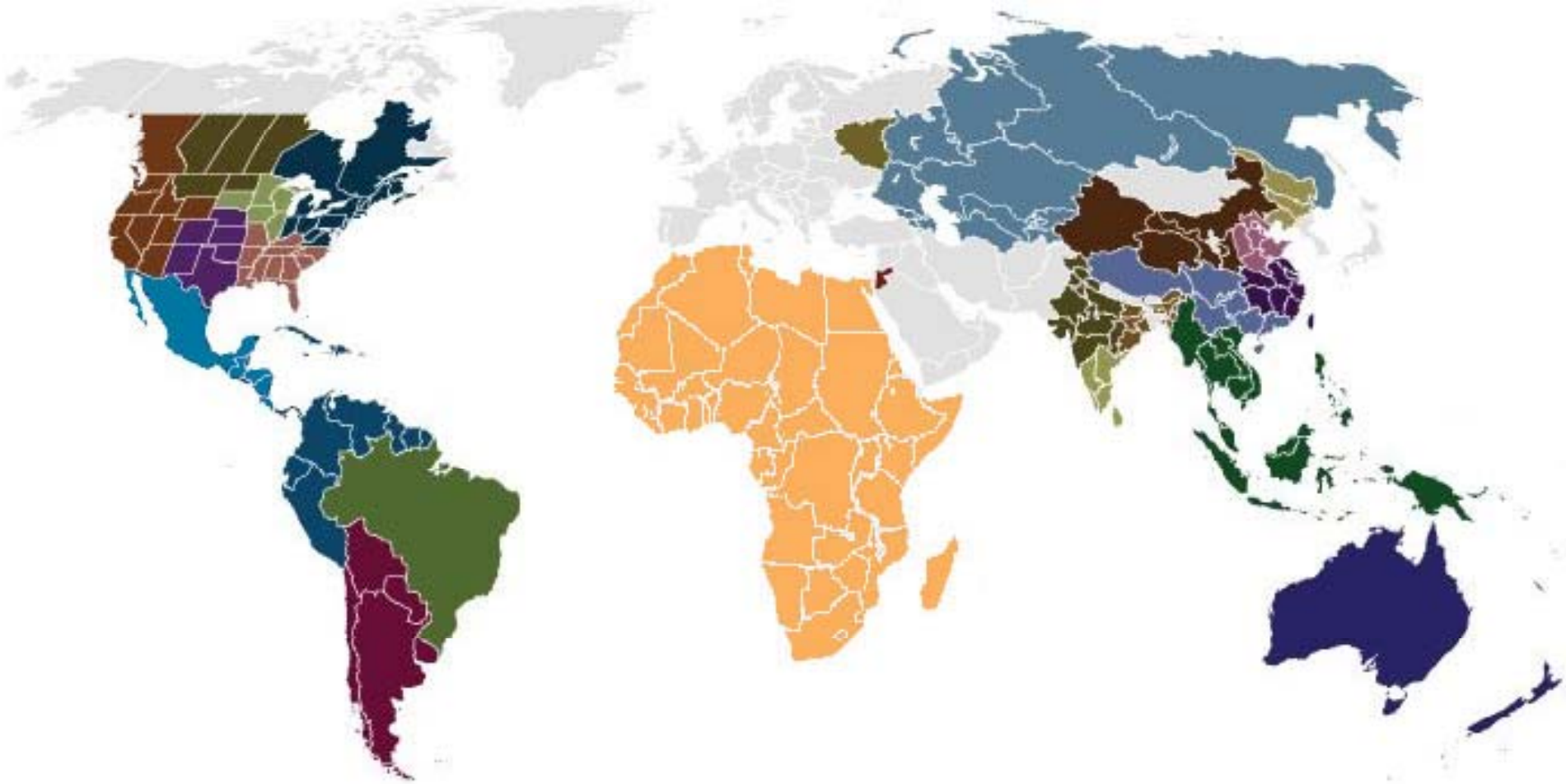
IPNI Mission

"to develop and promote scientific information about the responsible management of plant nutrition for the benefit of the human family."



Outline – Technologies and Approaches for Managing Crop Nitrogen

1. What is 4R?
2. 4R technologies and practices
3. 4R adoption by agri-service providers
4. Reporting 4R performance
5. 4R research

4R nutrient stewardship

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1. What is 4R?

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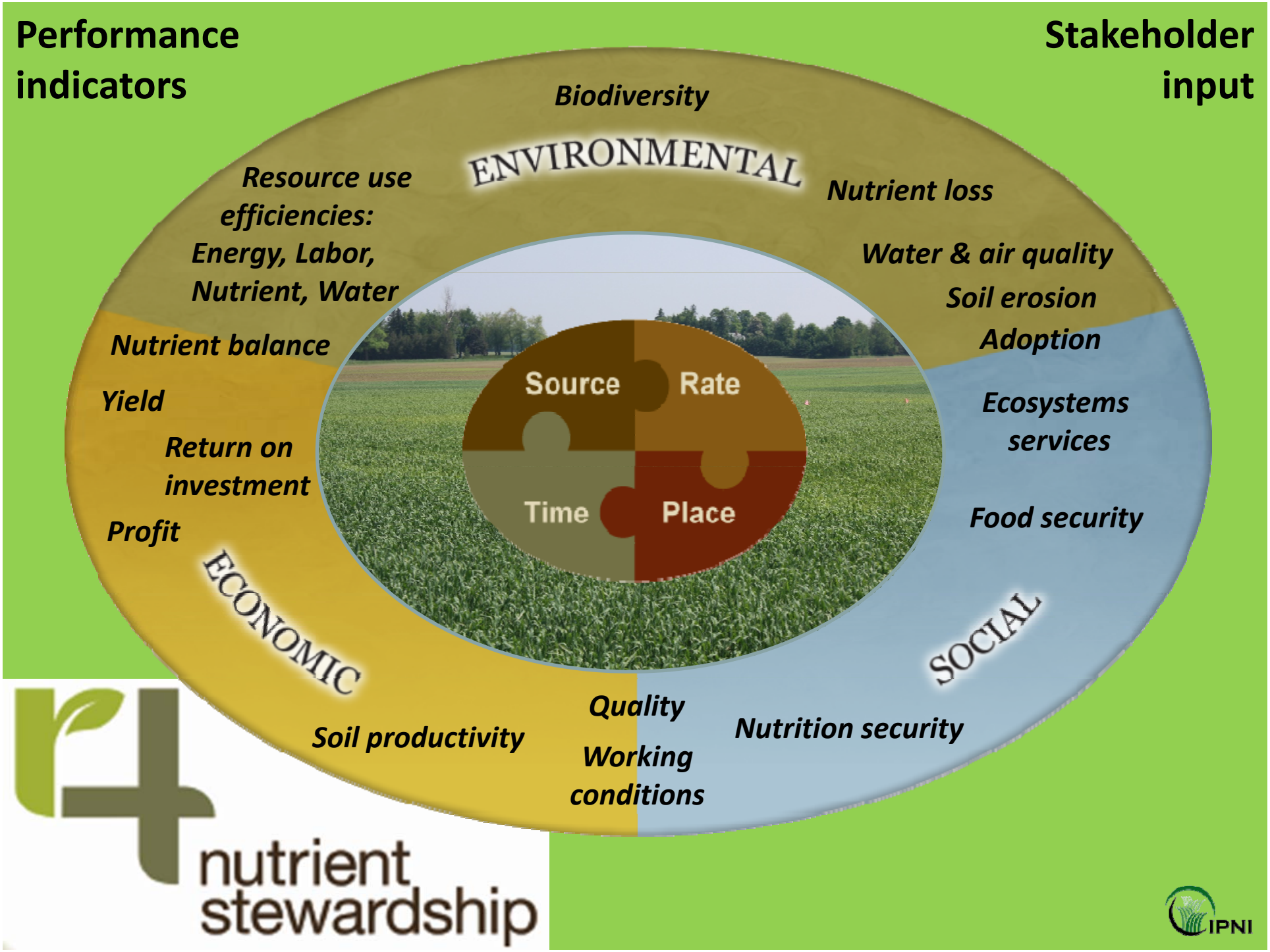
Performance indicators
Stakeholder input
Biodiversity
ENVIRONMENTAL
Resource use efficiencies: Energy, Labor, Nutrient, Water
Nutrient loss
Water & air quality
Soil erosion
Adoption
Nutrient balance
Yield
Return on investment
Profit
Source
Rate
Time
Place
Ecosystems services
Food security
ECONOMIC
SOCIAL
Quality
Soil productivity
Working conditions
Nutrition security
nutrient stewardship
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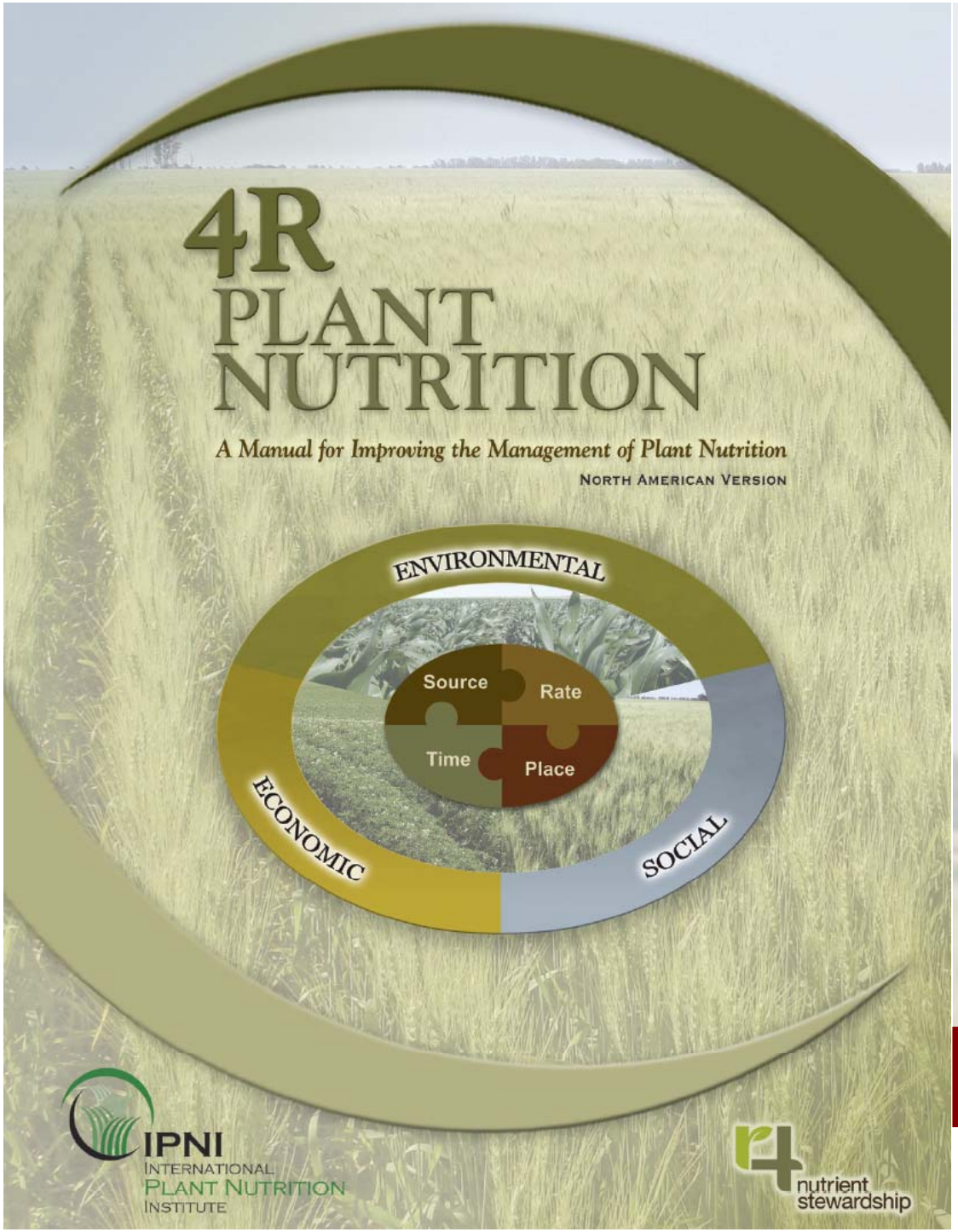

Chapter 1 Goals of Sustainable Agriculture .....

Chapter 2 The 4R Nutrient Stewardship Concept .....

Chapter 3 Scientific Principles Supporting — Right Source .....

Chapter 4 Scientific Principles Supporting — Right Rate .....

Chapter 5 Scientific Principles Supporting — Right Time.....

Chapter 6 Scientific Principles Supporting — Right Place.....

Chapter 7 Adapting Practices to the Whole Farm .....

Chapter 8 Supporting Practices.....

Chapter 9 Nutrient Management Planning and Accountability.

http://nane.ipni.net

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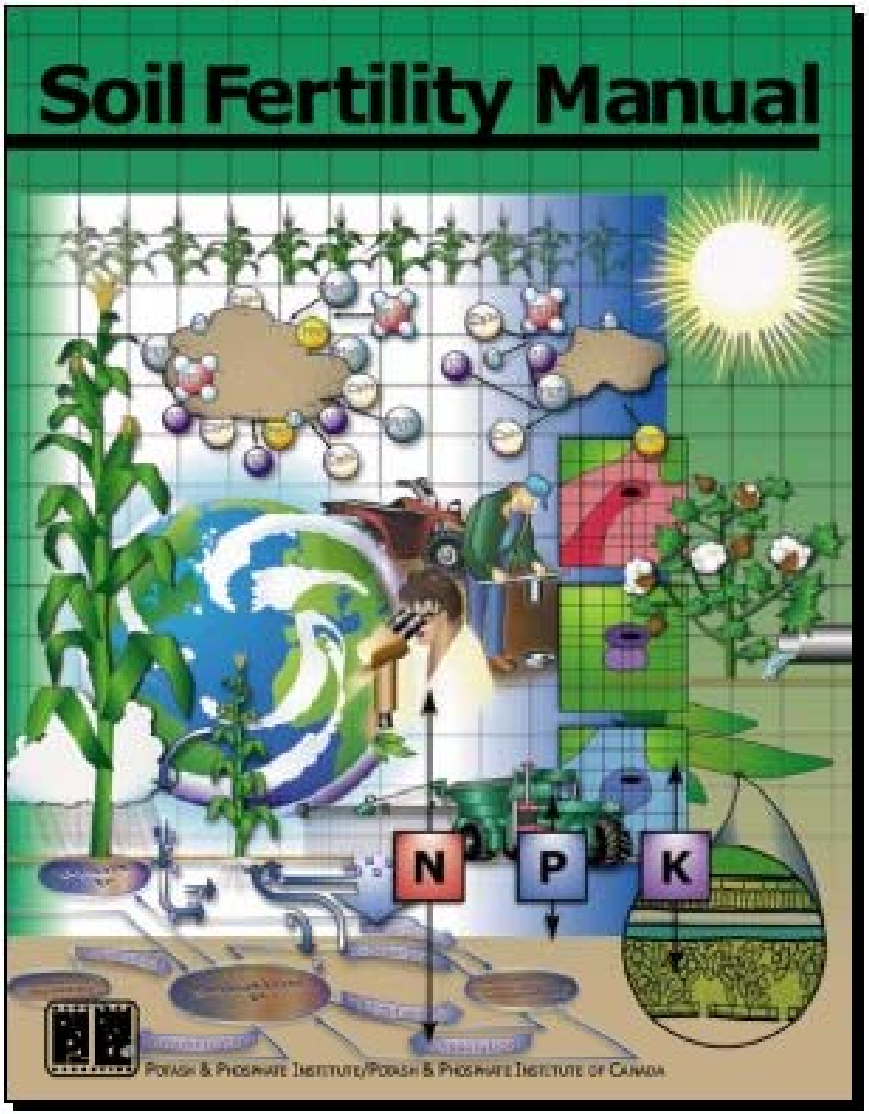
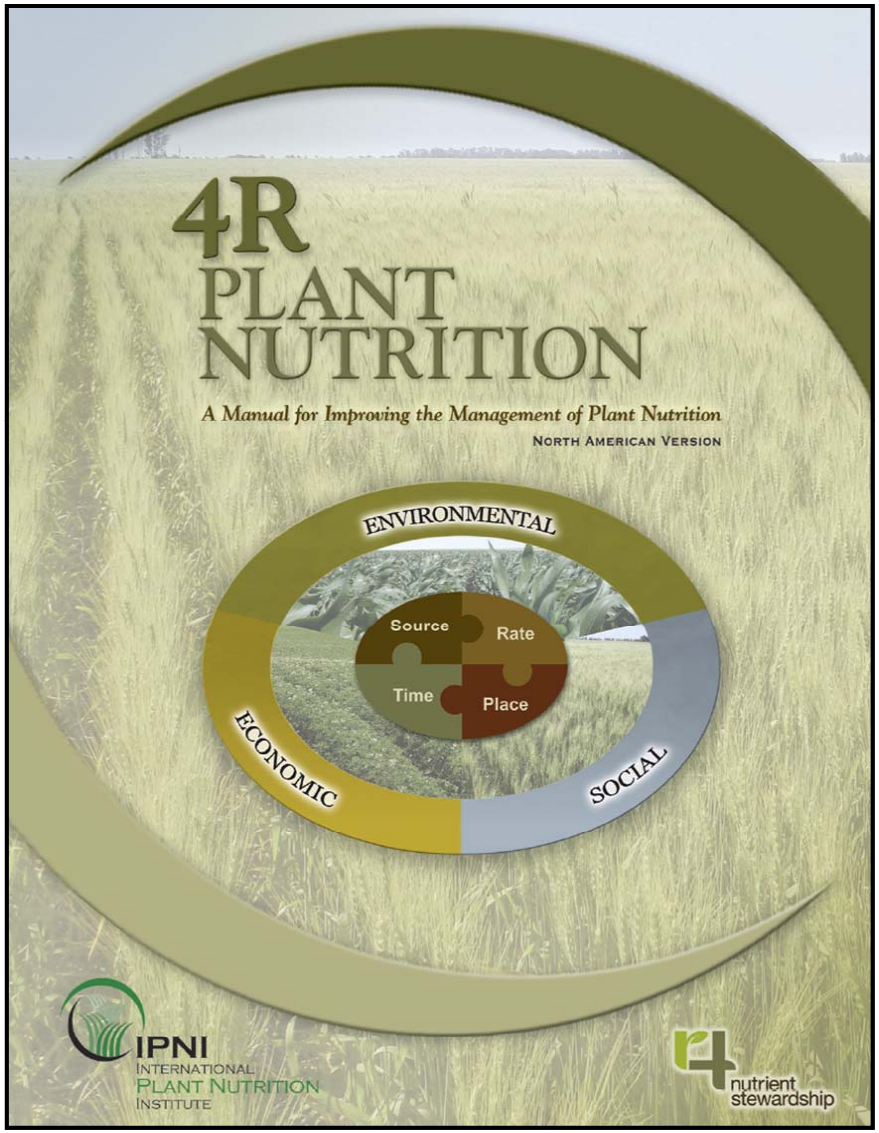
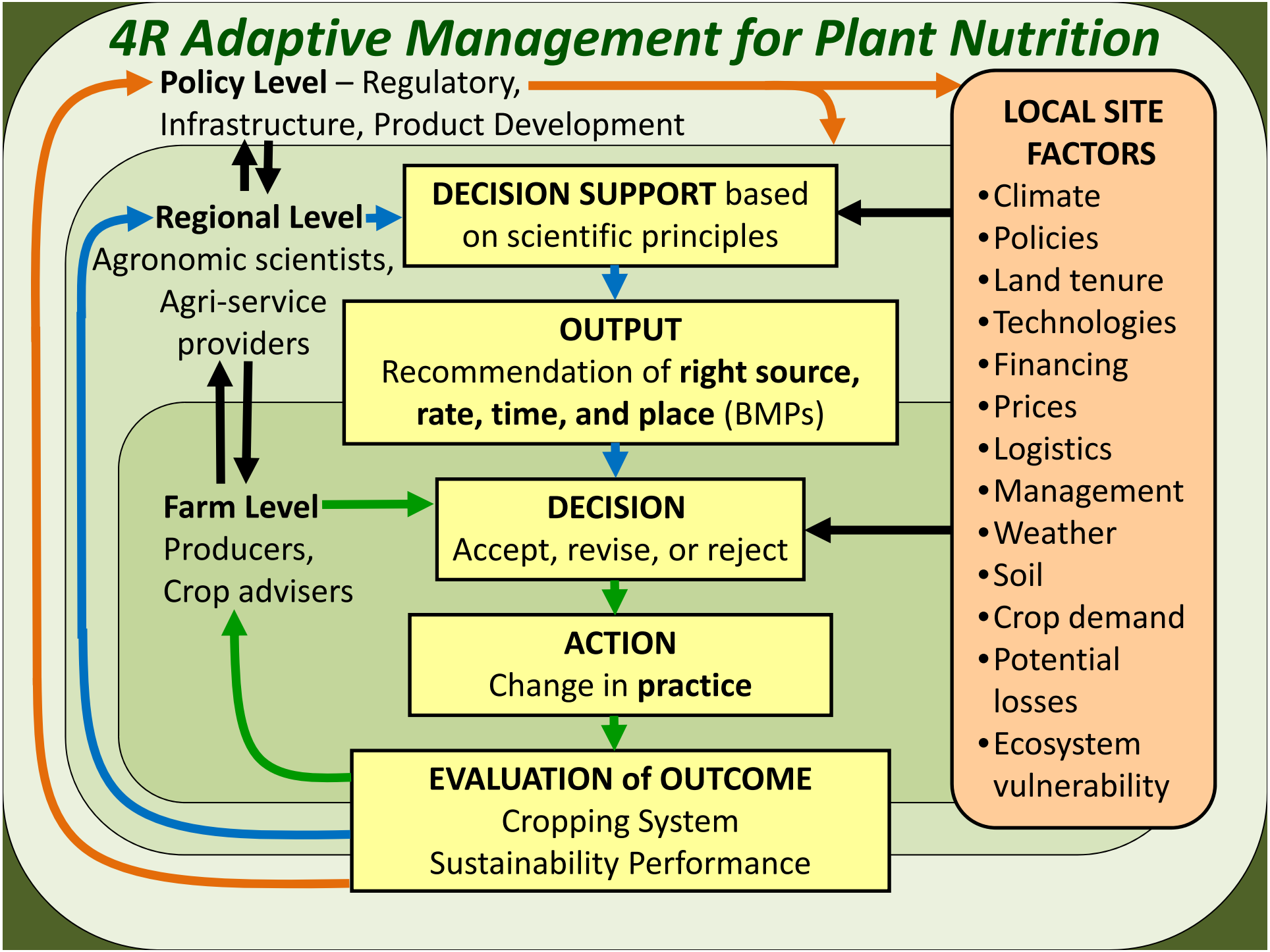
What's different?






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

2. 4R technologies and practices

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Right Source

Scientific Principle:

- Ensure a balanced supply of plant-available forms of N, utilizing all available sources.

Practices:

- Credit N from manures and composts
- Credit N from previous crops
- Assess use of enhanced-efficiency sources
    - Granular versus fluid
    - Inhibitors of urease and nitrification
    - Coated fertilizers

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New Technology

1. Synthetic organic compounds containing N
   - urea-formaldehydes, IBDU, triazones, etc.

2. Physical coating or barrier around soluble N fertilizer
   - Sulfur-coated or polymer-coated urea.

Dow AgroSciences N-Serve® Nitrogen Stabilizer

3. Stabilized materials
   - urease and nitrification inhibitors

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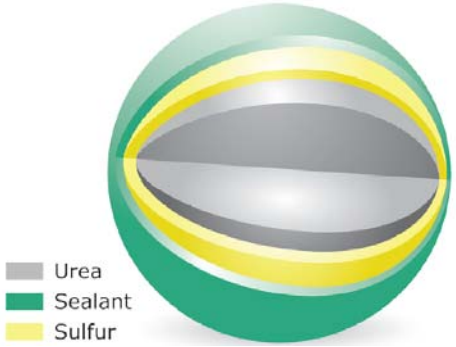
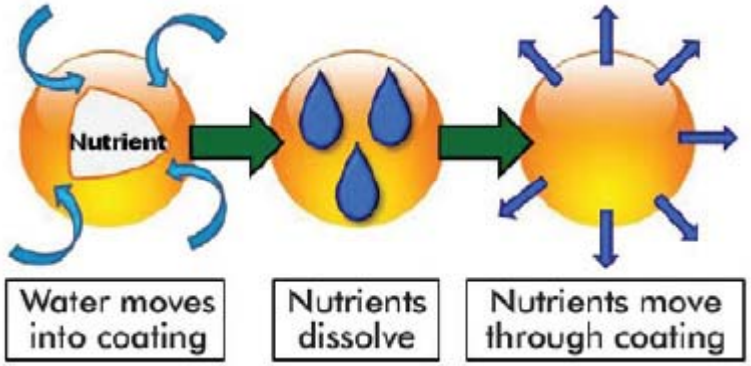
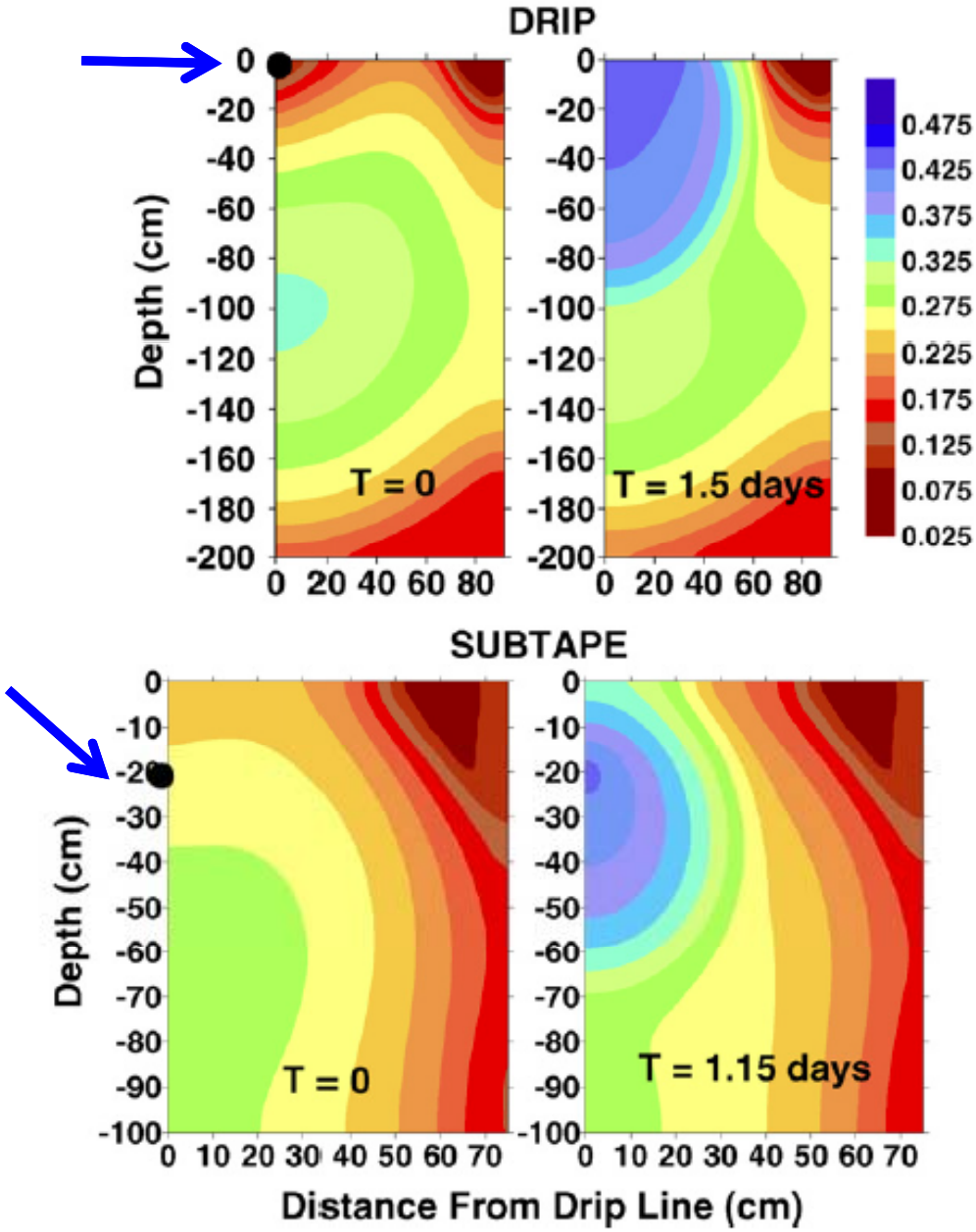


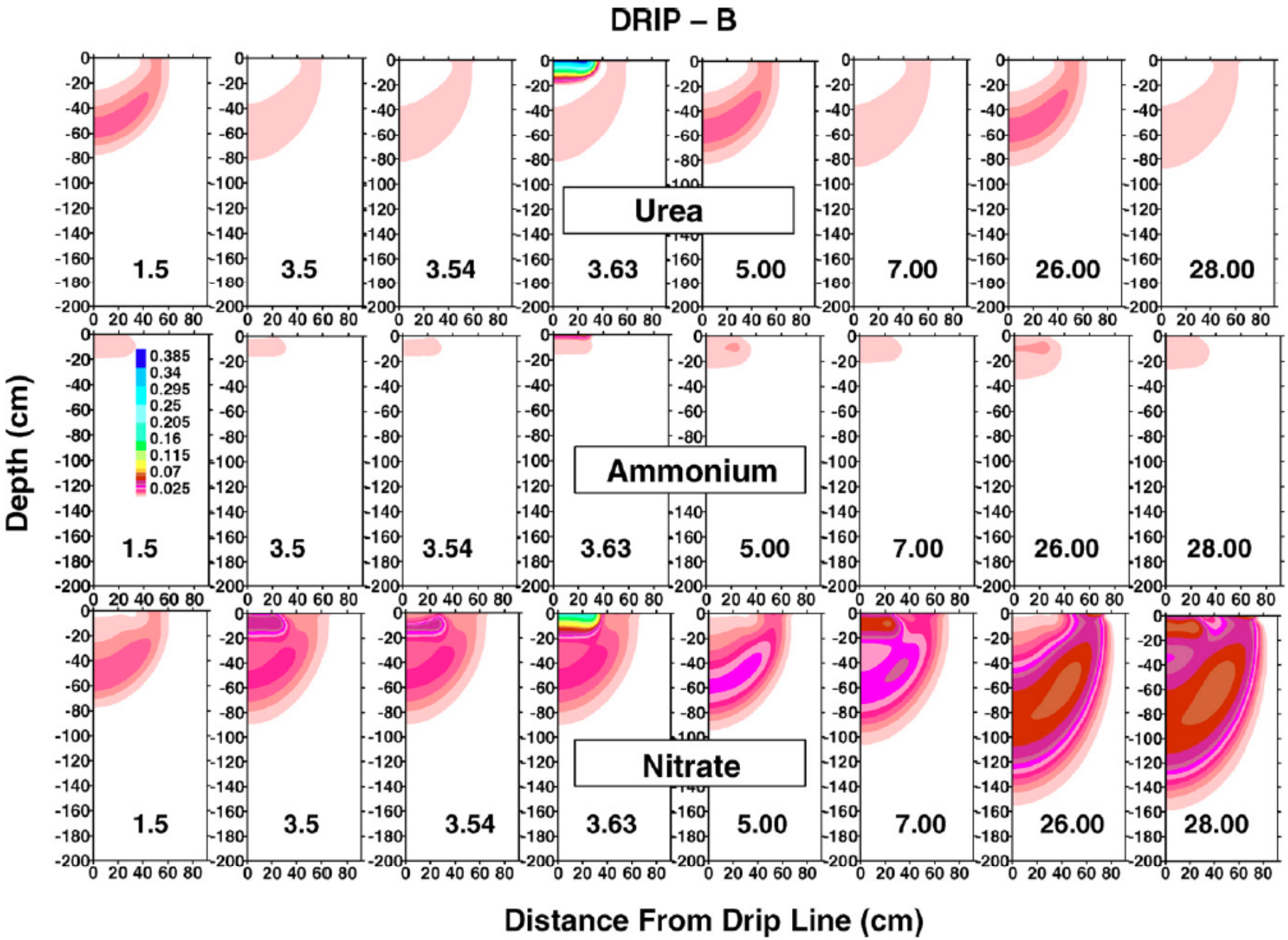


Water management is essential for N management



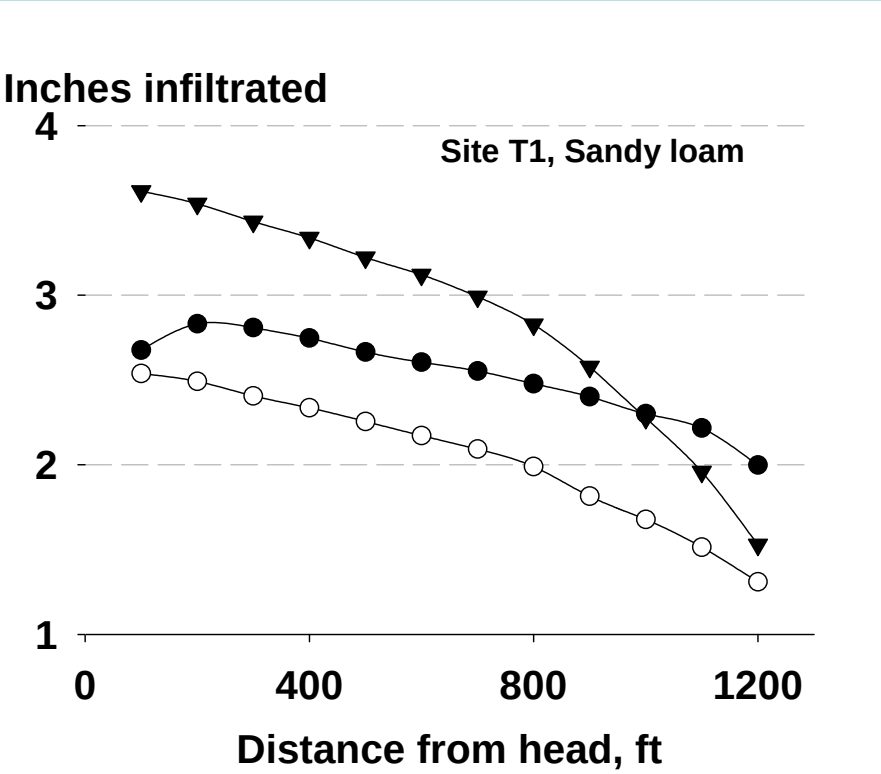
Volumetric water content at the start and conclusion for surface and sub-surface drip

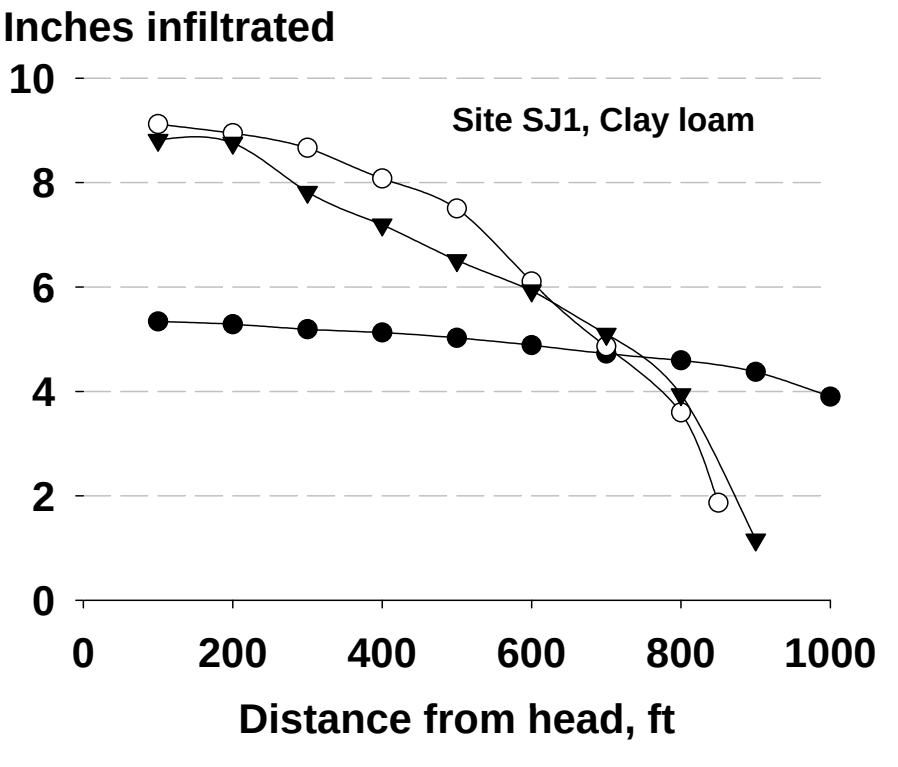
Hanson et al., 2006



Hanson et al., 2006

No Nitrogen Efficiency without Water Efficiency





from G.S. Pettygrove FREP project:
Nitrogen Fertigation in Furrow and Border Check Irrigation Systems

Right Rate

Scientific Principle:

- Assess soil nutrient supply and plant demand for N.

Practices:

- Soil testing
- Tissue analysis
- Balance crop removal
- Determine crop yield potential
- Assess price ratios

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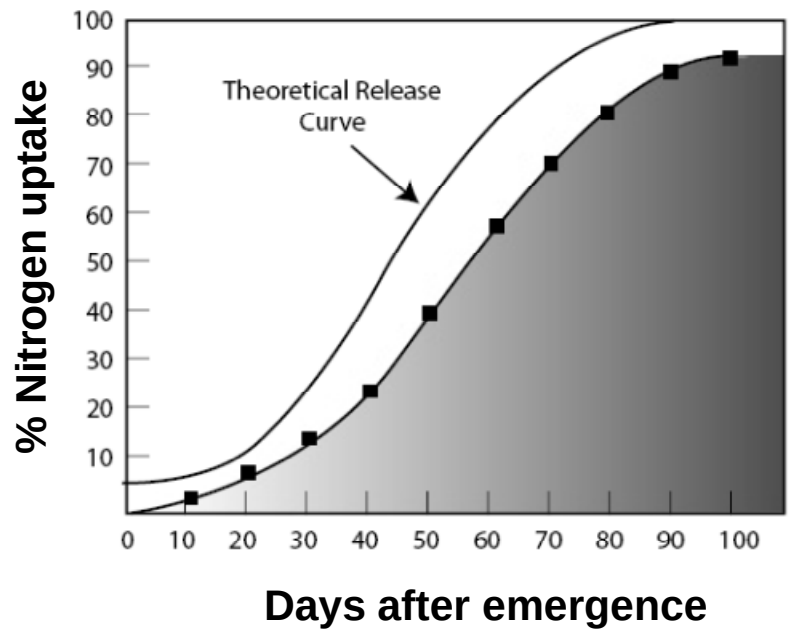
Right Time

Scientific Principle:

- Assess timing of crop uptake, soil nutrient supply, weather, loss risks and field operation logistics.

Practices:

- Split-application for sandy soils
- Cover crops to capture nutrients
- Suit tillage and planting operations



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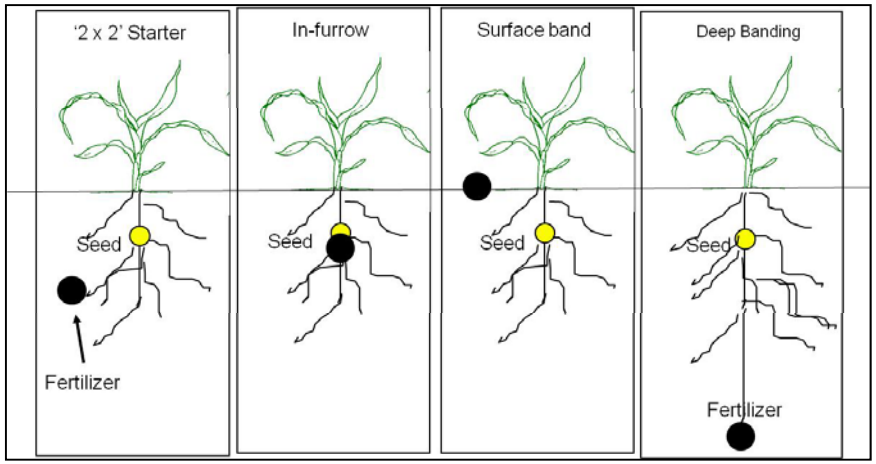
Right Place

Scientific Principle:

- Place nutrients where they are accessible to the crop.

Practices:

- Site-specific sensing technologies
- Starter placement near seedlings



nutrient stewardship

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3. 4R adoption by agri-service providers

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Search... GO

WHAT ARE THE 4RS | IMPLEMENT THE 4RS | 4R TRAINING

4R CONSISTENT SYSTEMS

These systems are consistent with the 4Rs and can help you create a comprehensive 4R nutrient stewardship plan. Learn more about what it means for a nutrient management system to be 4R-Consistent.

WILBUR-ELLIS COMPANY
14300 Nicollet Ct., suite 203
Burnsville, MN 55306
ph: 952-898-5562

THE ANDERSONS, INC.
The Andersons, Inc PO Box 119
Maumee, OH 43537
ph: 800-537-3370

SIMPLOT
999 Main Street, Suite 300AVAIL
Boise, ID 83702

IMPLEMENT THE 4RS

4R Nutrient Stewardship represents an innovative approach to fertilizer best management practices (BMPs). The 4Rs imply there are four aspects to every fertilizer application and it provides a framework to assess whether a given crop has access to the necessary nutrients. Asking "Was the crop given the right source at the right rate, at the right time, and in the right place?" helps identify opportunities to improve fertilizer efficiency and prevent nutrient movement from each field.

To learn more, please download our brochure: Implementing 4R Nutrient Stewardship on the Farm Right Now

This is an example of an unpublished revision.

RIGHT SOURCE | RIGHT RATE | RIGHT TIME | RIGHT PLACE

PARTNERS WITH THE PRODUCTS AND SERVICES YOU NEED TO FOLLOW THIS PART OF YOUR 4R PLAN

The Fertilizer Institute
Nourish, Replenish, Grow

Canadian Fertilizer Institute
Institut Canadien des Engrais

IPNI International Plant Nutrition Institute

International Fertilizer Industry Association

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“4R Inside” 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

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YouTube

Browse | Movies

4R Advocate Winners 2012

FertilizerInstitute | Subscribe | 1 video

4. Reporting 4R Performance

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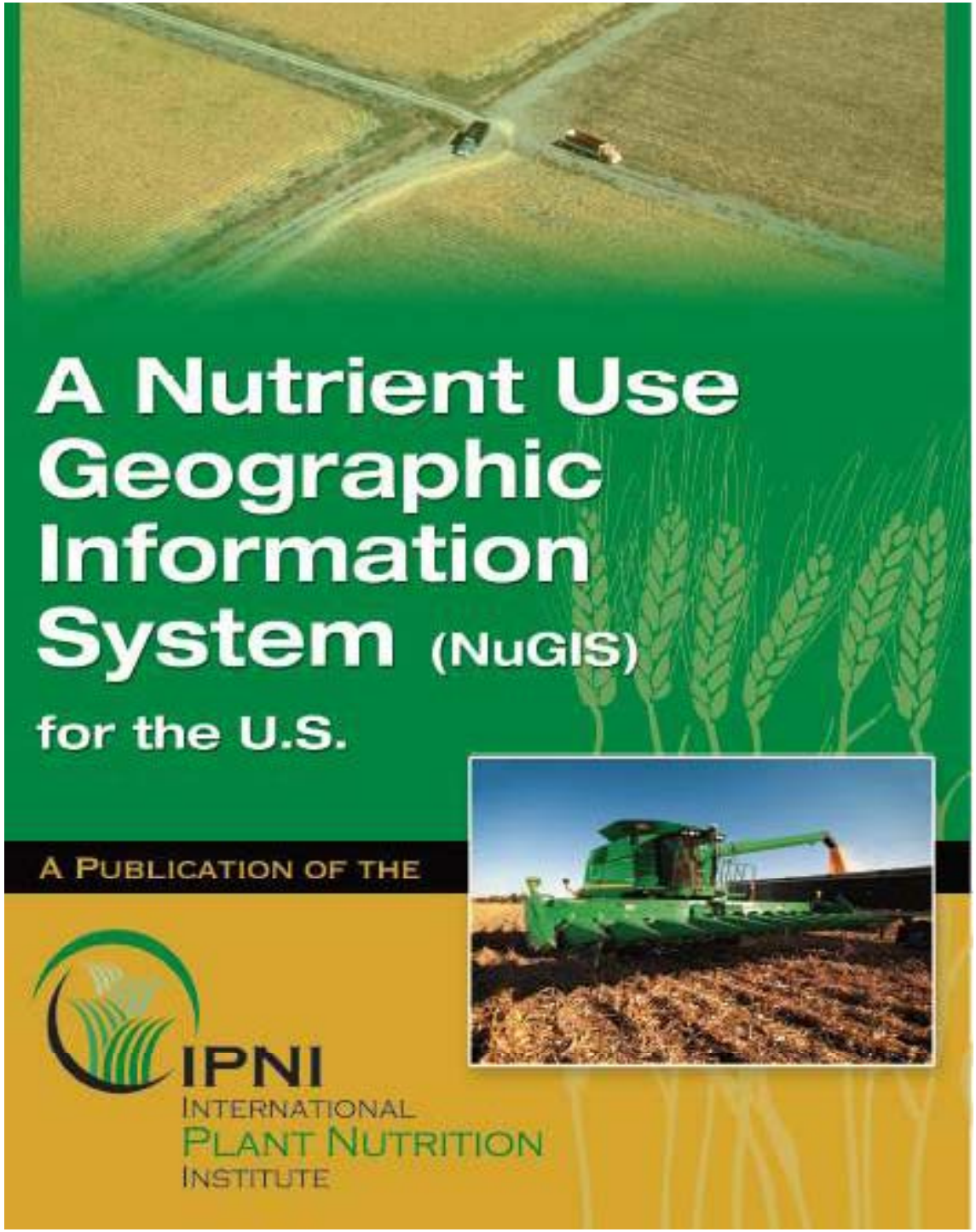
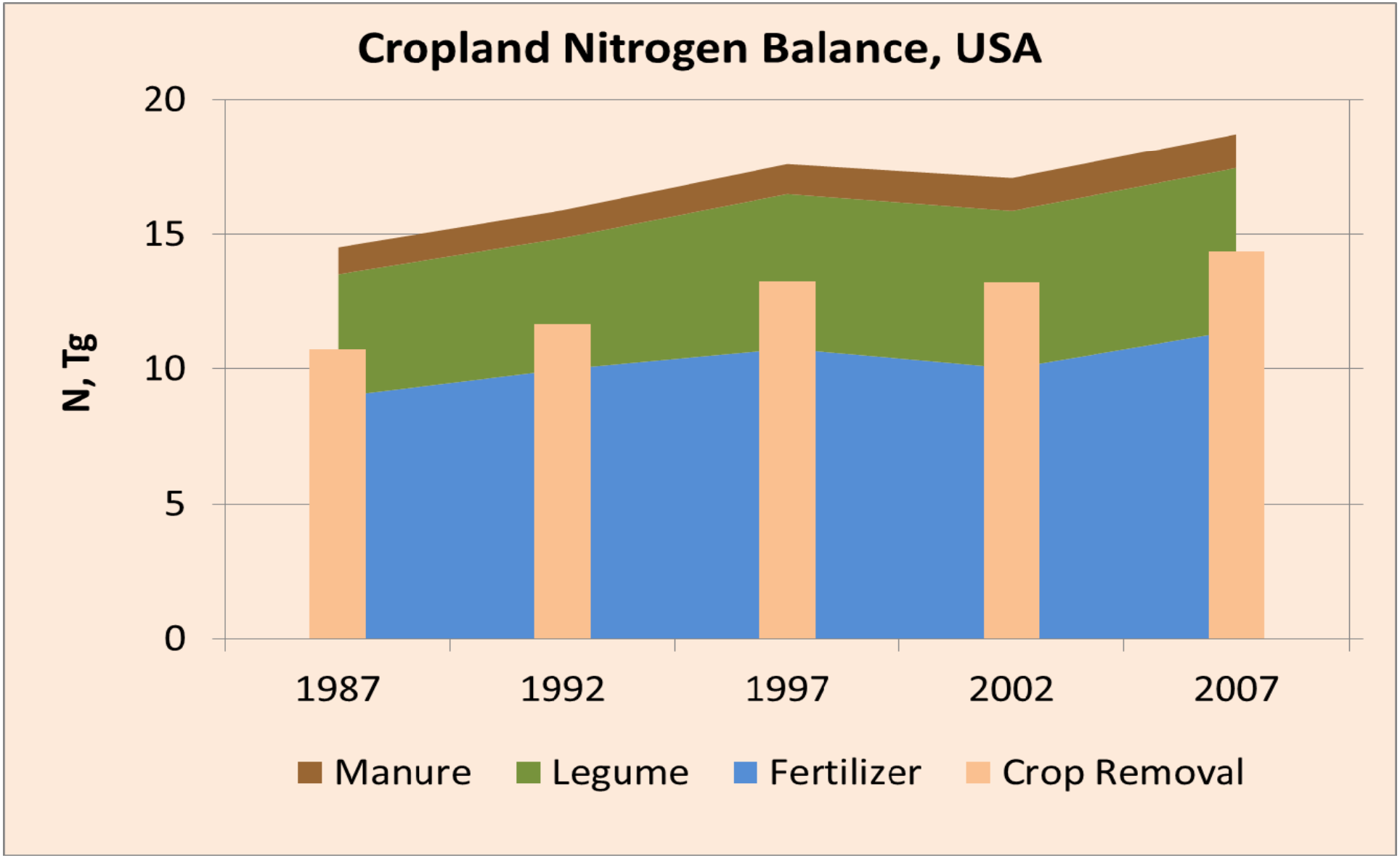
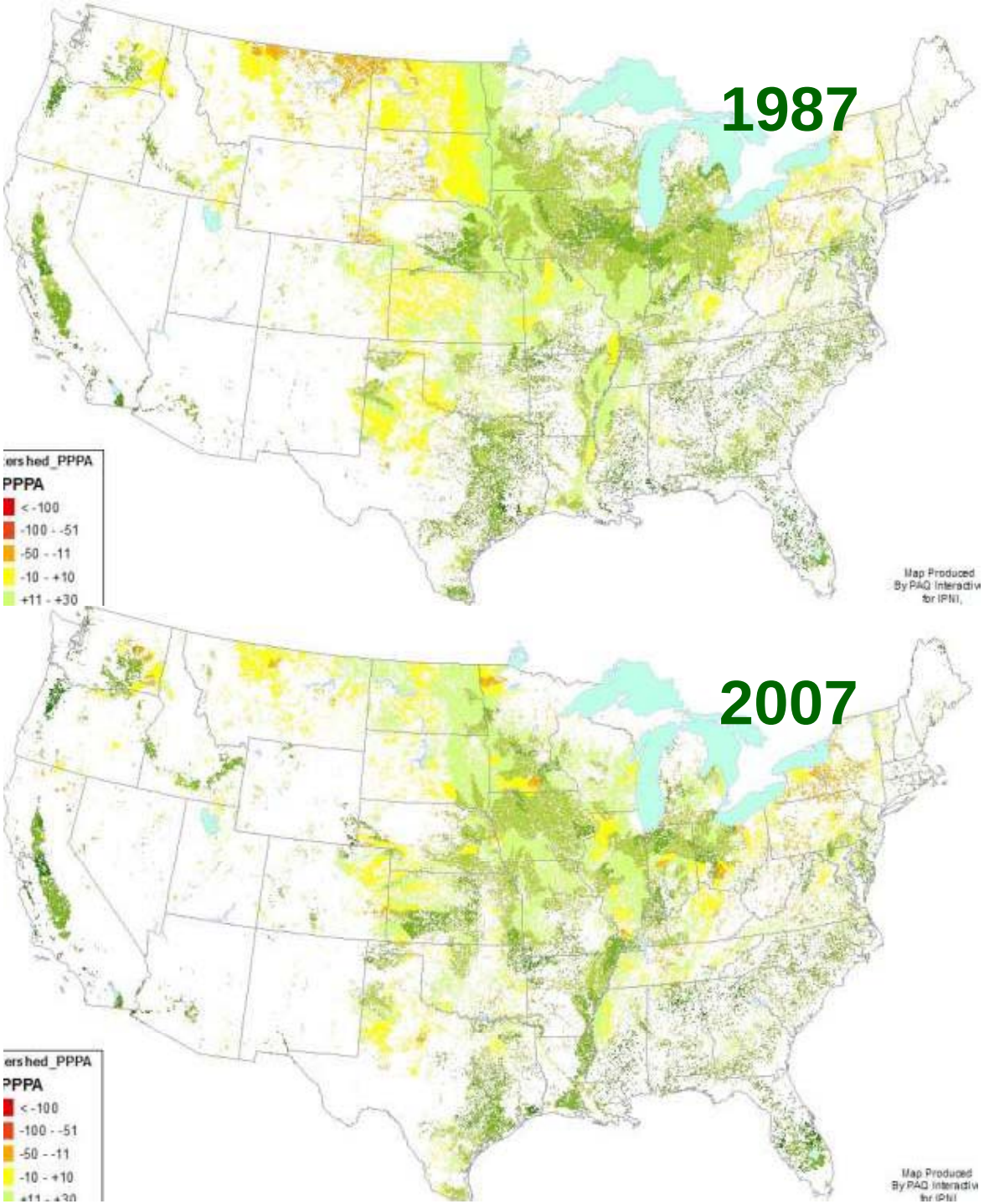

A Nutrient Use Geographic Information System (NuGIS)
for the U.S.
A Publication of the
IPNI
International Plant Nutrition Institute



Inputs of N to US agricultural land, including recoverable manure, legume fixation, and commercial fertilizers, as compared to removal by crops (adapted from IPNI NuGIS, 2011 & Robertson et al., 2012.

Partial N balance by 8-digit hydrologic unit



lb N/planted acre

- < -100
- -100 - -51
- -50 - -11
- -10 - +10
- +11 - +30
- +31 - +50
- +51 - +150
- +151 - + 300
- > +300

U.S. Partial N Balances (NuGIS 2011)

	1987	1992	1997	2002	2007
	kg N ha^{-1}				
Per harvested cropland	**36**	**38**	**37**	**33**	**36**

- U.S. N balances are considerably lower than those similarly estimated for 2002-2004 in:
- Netherlands **229**, Germany **113**, EU-15 **83**, OECD **74**, France **54**, and the United Kingdom **43**, and similar to the N balance for Canada **35** kg N ha^{-1} (OECD 2008)

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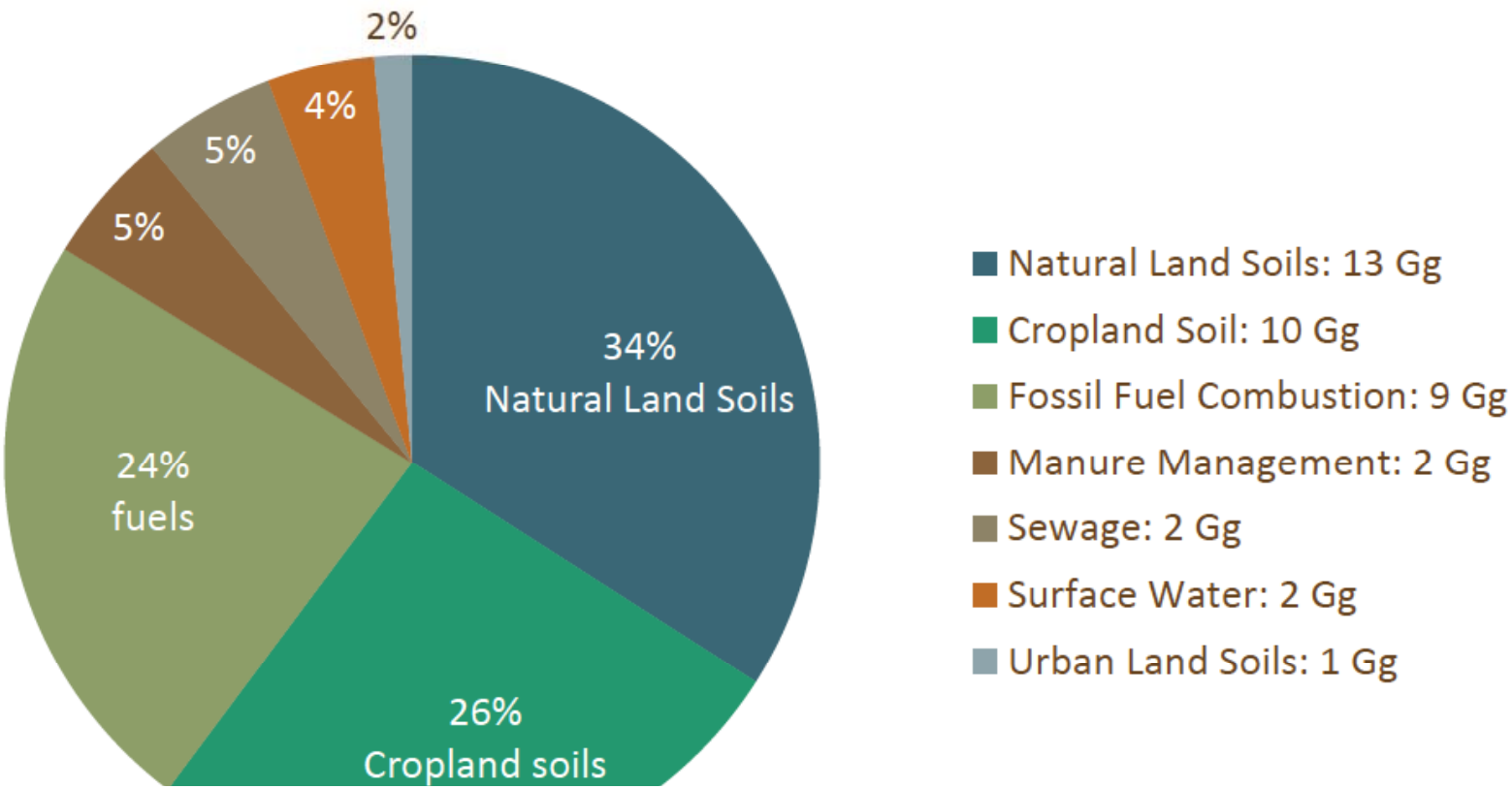
N_2O Emissions:

42 thousand tons (38 Gg) N per year

(Nitrous oxide emissions = about 2% of total statewide N inputs)



More than 80 pounds of nitrogen per acre per year may leach into groundwater beneath irrigated lands, usually as nitrate.

5. 4R research

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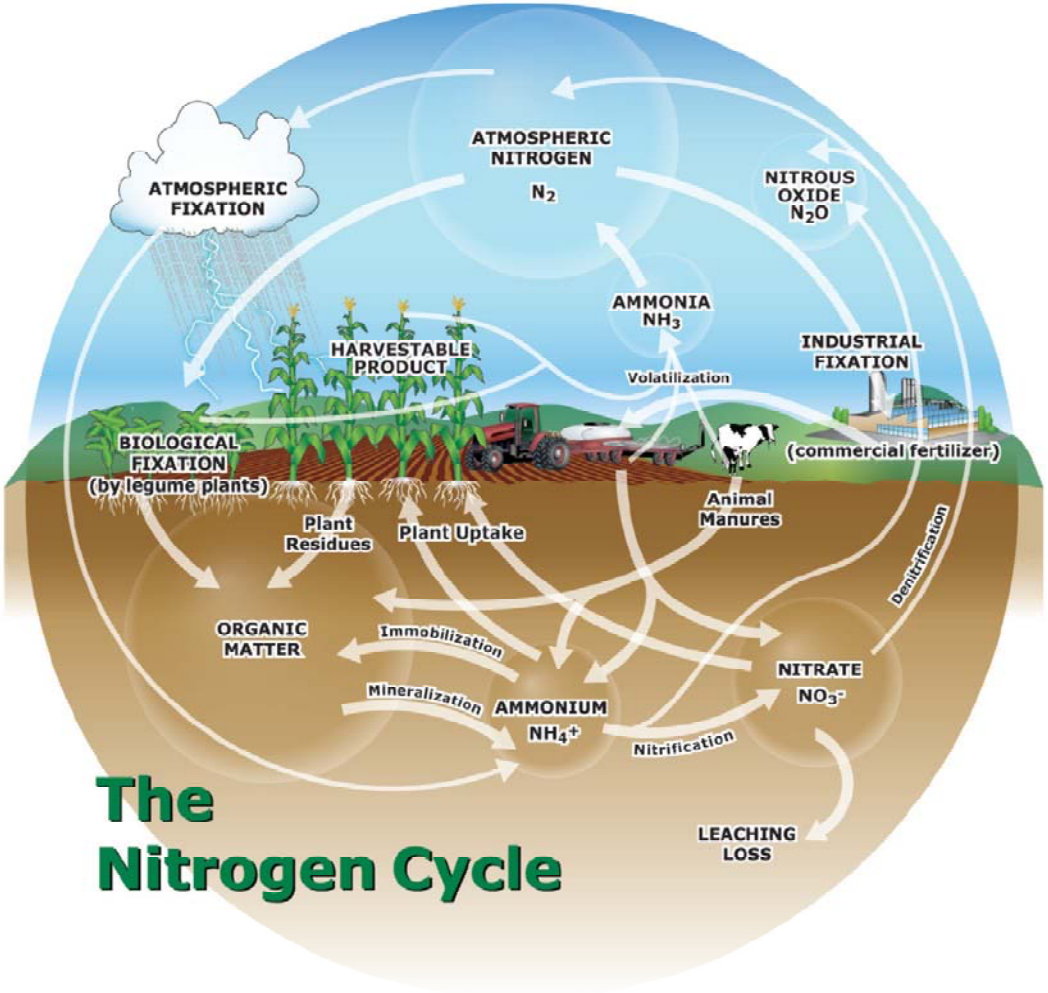
4R Applied Research Needs for N

…validation of efficacy of specific application practices
…environmental impact per unit of economic and social value

1. Adapting N management to weather
2. Ammonia emissions from wheat
3. Integrated management for ecological intensification
4. Nitrate leaching from high-value fruit, vegetable and tree crops
5. Nitrate leaching from field crops
6. Nitrate leaching index
7. Nitrous oxide emissions
8. Practice indicators
9. Research infrastructure
10. Sensor-based variable-rate N



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Summary – Nitrogen Technologies

1. 4R connects science to sustainable management of plant nutrition.
2. 4R technologies and practices are available.
3. Agri-service providers are making improvements through voluntary measures by adopting 4R.
4. Reporting 4R performance requires collaboration among producers, agri-service providers, and government.
5. 4R research needs to focus on validating sustainability performance of specific 4R practices

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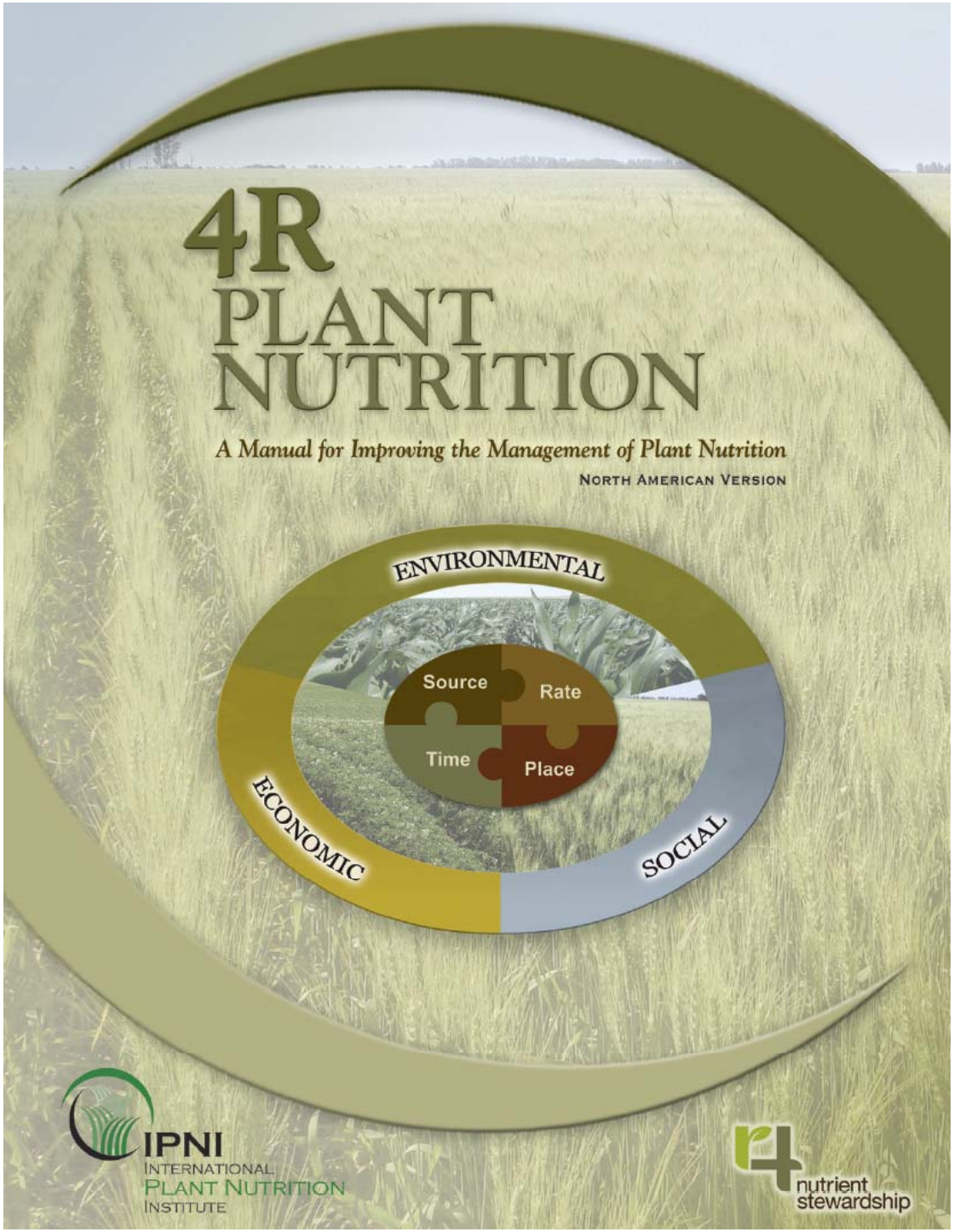
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A Manual for Improving the Management of Plant Nutrition
North American Version
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Time
Place
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